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ABSTRACT

Marine career information is provided, intended for use by high school students, counselors, teachers, and curriculum developers. Material was gathered from a review of occupational publications, including extended use of the "Dictionary of Occupational Titles" (D.O.T.), and from interviews of persons employed in marine occupations in Texas. Marine industries discussed are fish and foods, harbor maintenance and activities, marine recreation and tourism, merchant marine, petroleum, research and development, and shipbuilding and repair. Each industrial group is discussed generally, pertinent specific information is given (such as education, eligibility, employment outlook), and occupations are listed at length and described, largely from the D.O.T. (SC)

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MARINE OCCUPATIONS
in the Texas Coastal Zone

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Beryl McKinnerney and Donald L. Clark
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MARINE OCCUPATIONS IN THE TEXAS COASTAL ZONE

Beryl McKinnerney and Donald L. Clark

College of Education

Texas A&M University

July, 1973

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TEXAS A&M UNIVERSITY
COLLEGE OF EDUCATION
COLLEGE STATION, TEXAS 77843

Office of
THE ASSOCIATE DEAN

TO THE READER:

We are pleased to present this publication of marine occupations in the Texas Coastal Zone for your enjoyment and information. The material comprising this publication was compiled through an extensive review of occupational publications and interviews with people associated with marine occupations in Texas. The draft of this publication was reviewed by a jury of personnel actively involved in marine-related occupations in Texas.

The project staff invites you to serve as a member of the second jury in making comments concerning the material presented in this publication.

Sincerely,

Donald L. Clark
Project Director

PREFACE

This report has been prepared for high school students, counselors, teachers and curriculum developers who are interested in marine career information. Although considerable occupational information exists in most areas of employment, a limited amount of information relating to the marine industry is available. The intent of this report, therefore, is to achieve two goals: a) to benefit students and educators in marine career education and b) to stimulate others to write in this area.

The project was developed according to the following procedure: 1) review of available literature to identify marine occupations in the Texas Coastal Zone, 2) extensive interviews and correspondence with persons directly related to respective marine occupations in order to identify, update and revise listings and job descriptions (persons interviewed included educators, employees of state and federal governments and representatives of labor and management), 3) development of a draft copy of marine occupations and their descriptions, 4) submission of drafts to individuals in education and industry for further modification and corrections, 5) development of a final draft from the revised material and 6) submission of the final copy to the Sea Grant staff for editing and distribution.

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MARINE OCCUPATIONS IN THE TEXAS COASTAL ZONE

Introduction

The Texas Coastal Zone offers a wealth of exciting and diverse job opportunities for persons interested in marine careers. The purpose of this study, therefore, is to identify and to describe these marine occupations for prospective employees. This prospect is only a beginning; many modifications are needed to fill existing gaps. However, a general structure has been established, and continued research will supply missing information.

Marine-related industrial and recreational activities along the Texas coast play major roles in the state economy. Many varieties of finfish and shellfish provide sport for fishermen and income for the commercial fishing industry. Ships are continually constructed, repaired and modified, increasing the overall state economy. The recreational small-boat business adds still another dimension to Texas industry. In addition, large amounts of petroleum and natural gas are buried beneath the ocean floor, from the state shoreline to the outer edge of the continental shelf in the Gulf of Mexico.

Research, too, plays an important role in developing the Texas Coastal Zone. Researchers engage in numerous scientific projects that help the state and the nation to understand more thoroughly and to use more efficiently our limited natural resources.

Because coastal activity is so plentiful and varied, many opportunities beckon those persons desiring marine-oriented work. Adventure-seekers can pursue employment aboard ocean-going vessels or can harvest seafood within the confines of the continental shelf. Building or maintaining offshore rigs may have appeal for individuals attracted to rough, physical challenges. In addition, there are persons interested in ship design or in discovering better methods of extracting minerals from the sea; they will need special training to acquire the necessary knowledge for their careers. Regardless of the individual choice, opportunities for marine employment along the Texas Coastal Zone are plentiful and diverse.

For this study, various industries and activities have been divided into the following areas: (A) Fish and Foods, (B) Harbor Maintenance and Activities, (C) Merchant Marine Industry, (D) Marine Recreation and Tourism, (E) Research and Development, (F) Petroleum Industry and (G) Shipbuilding and Repair. Basic occupations related to the above industries, with the exception of Marine Recreation and Tourism, are described on the following pages.

No attempt is made to define Marine Recreation and Tourism occupations. This neglect, however, does not mean that marine recreation and tourism play a minor role in coastal economy; indeed, the opposite is true. The Texas Coastal Zone is a popular recreational center not only for Texans but also

for inhabitants of other states. The occupations were not defined because the difficulty of distinguishing marine recreation from other forms of recreation prevented accurate job descriptions.

In areas where job descriptions were written, only those occupations showing a direct relationship to the sea are described. In many cases some of the basic jobs, such as clerical, sales and managerial positions, are not described.

A serious attempt was also made to classify occupations according to responsibility level. To do this, a modified version of Ann Roe's two-way classification of occupations was used (Roe, 1959).

Table I shows the structure used in classifying the job titles. The titles were placed in the various levels similar to the Roe classification mentioned above. The vertical columns relate to the adjacent columns (with the exception of Marine Recreation and Tourism). For example, water transportation is closely related to Fish and Foods as well as to the Petroleum Industry.

Some job titles were borderline cases, and determining their exact location was difficult. In some cases, the assignment of a job title to a particular level may be debatable.

Dictionary of Occupational Titles

Many of the job descriptions were taken from the Dictionary of Occupational Titles (D.O.T.). In many instances the descriptions found in the D.O.T. were modified to fit the particular job description, as suggested by the following statement from the D.O.T.: "Most of the jobs are defined in broad, all-inclusive terms. Consequently, not all definitions can be expected to coincide exactly with specific jobs in a particular establishment or a given locality. To have the greatest local applicability, the job definitions should be supplemented by information concerning specific jobs within the community" (Dictionary of Occupational Titles, 1965, p. III).

For occupations described that did not have an apparent D.O.T. definition and number, the first three digits of the D.O.T. classification that most nearly corresponded to the general description of the occupation were listed in order to give the occupation a general listing. However, several occupations could not be identified by a general listing. The D.O.T. numbers for these occupations were left blank, indicating that numbers need to be assigned to these occupations.

Standard Industrial Classification Manual

The Texas Employment Commission, in cooperation with the federal government, gathers employment data based on the Standard Industrial Classification Manual, which is prepared by the Office of Statistical Standards (Standard Classification Manual, 1967). In this presentation we will refer to the 1967 edition, even though a modified edition was published in early 1972.

OCCUPATIONAL GROUPING

Level	Fish and Foods	Water Transportation	Geophysical	Research and Development	Recreation
Level I Professional and Managerial		Captain			
Level II Semi-Professional		Chief Steward			
Level III Skilled		Deck Engine Mechanic			
Level IV Semi-Skilled		Oiler			
Level V Unskilled		Ordinary Seaman			

STRUCTURE OF OCCUPATIONAL CLASSIFICATIONS

TABLE I

The Standard Industrial Classification Manual (1967) uses 2-, 3- and 4-digit numbers to classify industries in the United States. The 2-digit classification is the most general, the 3-digit classification more specific and the 4-digit classification most detailed. For example, the 2-digit classification 09 represents the total fisheries industry (see p. 11 of the Manual); this 2-digit number is then subdivided into two 3-digit numbers---classification number 091 represents all fisheries except fish hatcheries, farms and preserves industry; this 3-digit classification number is further broken into four 4-digit numbers--for example, classification number 0912 represents the industry engaged in catching finfish.

Present Manpower Information

Every individual should be able to select a career that (a) is self-fulfilling and (b) makes a contribution to society. To help make this decision, information on current and future manpower requirements must be readily available. For example, if a high school student is considering a career in welding within the shipbuilding industry, he should know (a) where in the United States this skill is utilized, (b) how many individuals are presently employed in this occupation and (c) how many individuals (estimate) will be employed in this occupation in the future---5, 10 and 25 years. Before he can realistically select a career, the student must know what employment opportunities will exist in the future.

Presently much of the needed manpower data is not available. The principal reason for this inadequacy is that United States citizens have not given this problem sufficiently high priority in order to allocate the resources necessary for gathering and analyzing the data. Therefore, this paper provides limited data on employment opportunities within the marine industry in Texas and its coastal zone.

Table II presents the employment data that is available within the marine industry in the following manner: (a) the digit code, presented in the Standard Industrial Classification Manual (1967); (b) the industry title, presented in the Standard Industrial Classification Manual (1967), and in parenthesis the page or pages where this industry is found in the manual; and (c) the average monthly employment for the last three months of 1971.

Future Manpower Requirements

It is difficult to predict the employment changes that will occur in the marine occupations during the next five years. Employment in the fish and foods industry may decrease with the introduction of new technologies. Total employment in shipbuilding and repair is expected to increase because of the current emphasis on products or services in the marine recreation industries.

Most economists and people engaged in water transportation are confident that the quantity of materials shipped by water-going vessels will increase during the next decade. This increase will provide additional employment

TABLE II

AVERAGE MONTHLY EMPLOYMENT IN TEXAS FOR MARINE INDUSTRIES

Digit Code	Industry Title	Average Monthly Employment for Oct., Nov., Dec., 1971
09	Fisheries	
091	Fisheries, except Fish Hatcheries, Farms and Preserves (p. 11)	1,054*
098	Fish Hatcheries, Farms and Preserves (p. 11)	None reported
373	Ship and Boat Building and Repairing	
3731	Ship Building and Repairing (p. 183)	8,146
3732	Boat Building and Repairing (p. 183)	2,475
	Water Transportation	
441	Deep Sea Foreign Transportation (p. 209)	3,720
442	Deep Sea Domestic Transportation (pp. 209, 210)	1,123
444	Transportation on Rivers and Canals (p. 210)	536
445	Local Water Transportation (p. 211)	2,426
446	Services Incidental to Water Transportation (p. 211)	10,104

*These employment figures were gathered by the Texas Employment Commission, Austin, Texas. The figures include only those employees covered by the Texas Unemployment Compensation Act.

opportunities in the water transportation industries. However, new technologies will reduce the number of unskilled jobs and increase the amount of skilled jobs. This trend will require that students acquire a good general education and then, by additional training and education, prepare themselves to perform at a high proficiency level, whether as welders, draftsmen or ship captains.

FISH AND FOODS

Introduction

The people of the United States consume 11.2 pounds per capita of all fish and fish-related products on the world market. The leading country in per capita consumption is Sweden at 86 pounds per capita, while Japan is second with 61 pounds and Denmark third with 47 pounds per person.

The United States fishing fleet produces a sizable percentage of the total world fishery products. Texas ranks second in the nation in dollars produced. In 1971 there were 168,000,000 pounds of fish and shellfish caught on the Texas coast. A large percentage of this amount consists of America's most popular seafood--shrimp (Pew, 1971, p. 3). Of course, many other species are important to the commercial industry such as oysters, blue crabs, redfish, trout, snapper and drum. In addition, the Gulf of Mexico also has many other species of fish attractive to anglers.

In 1971 there were approximately 6,220 full-time fishermen and 1,000 part-time fishermen, a total of 7,220 commercial fishermen. The total number of plants (processing and wholesale) in 1971 was 817 with an average seasonal employment of 18,625 persons and yearly employment of 13,427.

Shrimp

Shrimp is the most valuable seafood resource in the United States. In 1971 the domestic shrimp fishery became a $166 million fishery, accounting for almost 25 percent of the value of all domestic seafood resources. This resource created more wealth than the next two most valuable species--salmon and tuna--combined (Knopf, 1970, p. 7).

The Texas coastline is approximately 375 miles long. From Sabine Lake south through Corpus Christi Bay, the shoreline is characterized by large estuaries--zones where river waters meet and dilute seawater--while the remaining coast is a long, narrow lagoon called Laguna Madre. Sabine Lake, covering 70 square miles, forms the smallest major estuary. Galveston Bay covers about 530 square miles and Laguna Madre a 490 square-mile area. The total estuarine area and bay areas cover 2,100 square miles (Moffett, 1970, p. 3). During their early life, most shrimp find sanctuary in this large, fertile region where they feed, grow and when mature, enter the Gulf of Mexico where billions are caught annually (Moffett, 1970, p. 85).

The ocean floors along the Gulf of Mexico are harvested by shrimping vessels that pull trawls (nets). Shrimp trawls are cone-shaped bags with a wing on each side of the net opening. The opening at the mouth of the net may vary from 10 to 120 feet. The net body tapers gradually to form a narrow bag at the trailing end. Each wing is attached to heavy wooden outer doors with steel runners or "shoes" fastened to the bottom. Tow lines extend

from the doors to the boom of the boat. The net is towed through the water, acting as a large scoop held on the sea floor that produces a kite-like effect (Moffett, 1970, p. 3).

The average shrimp vessel is usually operated by three men: the captain, the rigger and the header. Robert Mauermann, president of the Texas Shrimp Association, has estimated shrimp vessels to be about 4,000 in number during summer 1972.

Oyster

In past years oysters were obtained by wading into shallow water and hand-picking them off an oyster reef one-by-one. Today only a small percentage of commercial oysters are harvested by this method. Many people interested in only a bushel or two for their own private use may use this method.

Another method used in the past and still practiced by a few individuals in Texas today is the use of oyster tongs. Oyster tongs are two long wooden poles joined together like a pair of pliers. The tongs are equipped with a type of comb that rakes oysters off the reefs. The tongs are lowered into the water onto the reef. The scissor-like action scrapes the oysters into the basket and then brings them up to the boat. Hand-picking and tonging are not commercially popular in Texas.

A more efficient way to harvest oysters is with an oyster dredge. The dredge is a heavy, metal-framed basket with teeth along the bottom edge of the basket opening. As the dredge is pulled across the reef, oysters are scraped off and fall into the basket. When full, the basket is hoisted by hand or by power winches, then dumped aboard the deck. Other types of dredges are used in different sections of the United States. One type is a suction dredge, similar to a vacuum cleaner, that sucks mollusks off the reef and deposits them in a container aboard the trawler. A mechanical hoister scoops shellfish off the reef and brings them by conveyor belt to the vessels.

The methods described above, with the exception of the hand-picking method, are indiscriminate because they gather all kinds of material, including dead shells and young oysters, from the reef. To get top price for the oysters, the oyster fisherman must separate marketable oysters from the unwanted material. When the oysters are culled, the young oysters are again scattered over the reef so they can continue to grow.

When the fisherman has completed his catch, he returns to shore and sells his catch to the oyster dealers. Fishermen who use dredges for harvesting may sell from 10 to 50 barrels per day. Use of tongs, of course, does not yield that much.

The dealer sells the oysters in shell or shucked form. Shucked oysters are sold fresh in half pint, pint, quart and gallon containers; they may also be canned or frozen. In Texas most oysters are sold fresh-shucked. Oysters in the shell are packed in sacks and kept cool until sold.

Shuckers or openers are employed by oyster dealers to open oysters for the market. Opening an oyster requires a skill learned only by much practice.

After shucking, oysters are washed to remove foreign material. The shellfish are then packed in glass or metal containers and placed in ice until sold (Hofstetter, 1967, p. 26-27).

Crab

Presently the crab industry in Texas is small in terms of the pounds harvested from the coastal waters and in terms of its monetary value compared to that of the shrimp industry. However, the increasing demand for crab meat is encouraging.

The several crab-processing plants in Texas usually buy their raw meat supply from independent crabbers who "run" traps or pots periodically and then sell their catches to these plants. Generally the processing plants do not own crab boats or equipment and depend on independent crabbers for the needed supply. Although the number of crabs processed daily is hard to determine due to fluctuations in the industry, about 170,000 pounds of crabmeat were processed in Texas during 1971.

As soon as crabbers finish running their traps or pots (usually in the evening), they bring the catches to the plant. The crabs are processed as quickly as possible to prevent spoilage and contamination. A strict sanitation code must be maintained by the processing plant.

Live crabs are placed in a boiler, vat or steamer made of steel and concrete; the cooking container usually has a capacity of 600 gallons and will hold 1,200 pounds of crabs. Most cooking is done in the evening or at night as soon as the catch is received. After the crabs cook for about 20 minutes, they are cooled in large metal cans with perforated sides. After cooling, the crabs are transferred to a stainless steel "backing table" where backs and claws are removed, then separated into large containers. After the crabs are washed in large metal bins in one room, they are sent to a large, well-lighted picking room. Pickers, seated at long tables, work rapidly; their pay, based on the number of pounds of meat they pick, is usually 20 to 25 cents per pound. A crab plant operator estimates a 14 percent yield; that is, if 100 pounds of average-size whole crabs are picked, he counts on about 14 pounds of meat. An average picker yields about 8 pounds of meat per hour, although some can pick as many as 15 pounds in an hour. The crab meat is placed in one-pound cans by packers, then moved to a weighing room where the meat is checked for exact weight and graded. Four grades of crab meat are produced by these plants: special white meat, in small pieces; claw meat; backfin lump meat, in great demand; and claw cocktail crab meat, an increasingly popular form that consists of the finger of the claw with the shell still attached (Leary, 1967, p. 15).

The basic occupations of the above industries are listed and described below according to industry and job title.

The Shrimp Industry

CAPTAIN (See D.O.T.--197.133): The captain manages the operation of the vessel. His work involves administrative and technical responsibilities for the operation, maintenance and safety of the vessel; planning and supervision of operations and maintenance on the deck and engine of the vessel; administration of business affairs such as purchasing, disbursing and insuring compliance with customs and immigration regulations; and piloting vessels through rivers, straits and harbors. He is also responsible for vessel operation when trawling for shrimp. He may also assist the rigman in handling trawls.

RIGMAN (RIGGER) (See D.O.T.--): The rigman does much of the deck work aboard the shrimp vessel; he operates the trawls and booms, cleans the net, helps in sorting, deheading, icing and unloading the shrimp. He may also assist in many details assigned to the captain.

HEADER (See D.O.T.--): The header's prime responsibility is deheading the shrimp, although he may be called upon to help the rigman in handling the trawls, sorting the catch, icing the shrimp, etc. His pay is based on the amount of the total shrimp catch returned for processing.

PRODUCTION SUPERVISOR (See D.O.T.--): The production supervisor ensures that all aspects of production operate smoothly. He checks to see that each function is performed properly and efficiently. In addition, the production supervisor also sees that proper personnel adjustments due to absenteeism are made.

SHELLFISH-PROCESSING-MACHINE TENDER (See D.O.T.--529.885): The shellfish-processing-machine tender operates washing, blanching, steaming, brining, peeling or shucking machines that prepare shellfish for canning, freezing or fresh packing. He opens valves to admit water, steam or air under pressure into machine vats and adds specified quantities of additives such as salt or food coloring; he lowers baskets of shellfish into vats by hand and hoists or pushes cars of shellfish into steam chambers. The tender starts conveyors that move the product through machines, and he may turn screws with a wrench to adjust tension of the peeler.

SHRIMP-PEELING-MACHINE OPERATOR (See D.O.T.--521.782): The shrimp-peeling-machine operator controls a peeling machine that deheads and peels shrimp prior to canning or freezing, spaces the peeling rolls according to size of shrimp being processed and adjusts holding rack bars to intermesh between rolls. The operator turns thumbscrews to adjust spring tension on holding rack bars according to shrimp size and turns valves to start water flow over rolls; in addition, he starts machines and feeds conveyor, then spreads shrimp over feed pan at head of rolls to ensure even distribution, using an aluminum or stainless rake. He examines random shrimp samples at the machine's discharge point to ascertain relative efficiency of peeling and heading operation, then adjusts roll-spacing and holding-bar tension accordingly. He also dismantles and cleans the machine with high-pressure stream

from a water hose; he may sterilize machine parts by directing hot water or steam over them.

QUALITY ASSURANCE DIRECTOR (See D.O.T.--): The quality assurance director oversees the control of all aspects of shrimp processing.

MICROBIOLOGIST (See D.O.T.--041.081): The microbiologist makes quality control checks to ensure that precautions are taken to maintain proper sanitation requirements. He investigates activities of bacteria and of other microorganisms in the manufacture, spoilage and deterioration of food; he isolates, cultures and identifies microorganisms that cause food decomposition as well as those of public health significance. He determines how foodstuffs become contaminated and the inhibiting development of objectionable microorganisms.

LABORATORY ASSISTANT OR SANITARIAN (See D.O.T.--381.887): The lab assistant aids the microbiologist in performing tests. He performs many manipulative tasks required for testing.

QUALITY CONTROL TECHNICIAN (See D.O.T.--): The quality control technician checks the percentage of breading added to shrimp. He also compares drained weight with glazed weight and checks organoleptic evaluation of raw green headless, whether the shrimp be fresh or frozen.

TASTER (See D.O.T.--381.887): The taster samples the shrimp to determine its palatability, checking salinity, etc.

LINE FOREMAN OR LINE SUPERVISOR (See D.O.T.--): The line foreman works in the processing area of the industry. He supervises those duties performed on his particular line or section.

FLOOR LADY (See D.O.T.--): The floor lady supervises people assigned to her section of the line. In addition to seeing that work is done properly and efficiently, she acts as a liaison between the women in line and the line supervisor.

PEELER (See D.O.T.--): The peeler also works in the processing area. He or she usually stands beside the conveyor belt, inspects the freshly washed shrimp and peels those not already shelled/dehulled. Peeling occurs prior to the breading procedure. Women usually perform this task.

BREADER (See D.O.T.): The breader, also in processing, works next to a conveyor that takes the shrimp through a breading process. The three tasks performed during this process are arranging, packing and weighing. One person arranges shrimp, tail first, on the conveyor so that none overlap and so that the shrimp can be evenly breaded. The packer boxes the shrimp. The third person then weighs the shrimp.

The Oyster Industry

OYSTERMAN OR DREDGER (See D.O.T.--436.884): From the mast and boom of a powerboat, the oysterman rigs and lowers a dredge into the shellfish bed, hoists a dredge, then pulls the dump ring in order to empty the catch. He

picks out market-size shellfish from the catch and replants the smaller ones. The dredger also packs and ices marketable shellfish in containers for shipment.

TONGER (See D.O.T.--436.884): The oyster tonger reaches from the boat and gropes for shellfish with rake tongs. He drags a brail rod--a pipe with a series of hooks attached--behind the powerboat to pull shellfish from the mud.

CULLER (See D.O.T.--): The culler separates the marketable oysters from other extraneous matter such as mud, dead shells or small young oysters. He often uses a small hatchet and employs great skill in order to avoid killing small young oysters that are returned to the reef.

OYSTER FLOATER (See D.O.T.--439.887): The oyster floater spreads freshly harvested oysters in a shallow barge or float where water can flow over the oysters to afford temporary storage. Oysters taken from beds that have been exposed to sewage are usually "floated" in water with a specified degree of saltiness (designated by health authorities) until oysters are free of impurities.

OYSTER SHUCKER (See D.O.T.--521.887): The oyster shucker shells fresh or steamed oysters prior to canning, freezing or fresh-packing. As he holds shellfish firmly or against a block, the shucker forces a shucking knife between the shell halves at the hinge pincture. He twists the knife to sever muscles that close the shell, then pries open. He cuts the oyster from the shell, flips it into the container and discards the shell.

The Crab Industry

CRAB FISHERMAN (See D.O.T.--431.884): This employee ties the marker float to the line, attaches the line to the pot, fastens bait inside pot and then lowers pot into water. He secures the marker floater with hooked pole and pulls up pot. He reaches through hinged door of pot to remove catch. Usually working independently on his own boat, the crabber runs several hundred traps, which he baits, and then collects the crabs to be sold to processors.

CRAB BUTCHER (See D.O.T.--525.884): Before the picking and canning procedures, the crab butcher grips a crab with both hands and impales it on a stationary spike. He twists, pulls and detaches the crab body from the back. After wiping off gills and viscera, he tosses the crab body into a vat of water. The crab back is discarded.

SHELLFISH PROCESSING LABORER (See D.O.T.--529.886): The shellfish processing laborer performs numerous tasks related to fresh-packing, canning, freezing or smoking shellfish. He transports shellfish, shellfish meats, cans or cases to the work area by hand, wheeled hopper, handtruck or power hoist. The processing laborer loads conveyors, hoppers or handtrucks with product, cans or cases. He spreads shellfish on the conveyor, drenches them with water and removes foreign matter. He weighs shellfish or shellfish meat, then records the weight on a standard form. He may sort shellfish according

to size and trim unusable portions with knife or scissors. After trimming, he packs shellfish meat in jars, cans or boxes and places the containers in crushed ice to fresh-pack. He also cleans conveyors, machines and work areas with a high-pressure hose spray. He may feed cans and lids into lidding machines. The processing laborer may be designated a shellfish checker, packer, sorter or weigher, according to the task performed.

HARBOR MAINTENANCE AND ACTIVITIES

Introduction

The majority of occupations related to harbor maintenance can be classified in one of the three following categories: (1) shiploading and unloading, (2) dredging and ship channel maintenance and (3) land-oriented harbor maintenance activities. These occupations maintain an efficient flow of goods and ships to and from the harbor area.

Two regulating agencies oversee the activities related to the upkeep of the harbor--the U.S. Corps of Engineers and the local port authority. The Corps of Engineers maintains a staff of surveyors, construction inspectors and engineers who provide information regarding the depth and accessability of shipping channels to merchant marine and port authority personnel. The Corps also prepares reports pertinent to construction and maintenance projects in the harbor area.

In addition, harbor maintenance (Corps of Engineers) includes those activities related to maintaining waterways along the Texas coast. These federally employed personnel are involved with hydrographic surveys required to determine the condition of waterways and the preparation of plans for required dredging to maintain navigation channels. These activities are conducted by the U.S. Army Corps of Engineers, which has area officers in Port Arthur, Galveston, Corpus Christi and Brownsville.

The local port authority maintains land-based harbor facilities such as docks, warehouses, grain elevators and other cargo storage facilities, as well as rail yards, truck terminals and container-handling equipment. In addition, the port authority acts as an agent between the producer and the shipper. In this capacity the port authority schedules and regulates a uniform flow of cargo in and out of the port.

This group of occupations includes the upkeep and maintenance of the wharf area, storage terminal and rail facilities that are used in transferring cargo to and from ships. Occupations related to rail maintenance activities, pier and wharf repair, grain elevator upkeep, yard train and tractor repair.

The actual loading and unloading of a ship's cargo is done by longshoremen. The activities of the longshoreman are initiated by the port authority, but the actual process of loading and unloading cargo is controlled and directed by longshore unions. A union agent is notified by the port authority of an incoming ship and is given a description of the ship's cargo. The union agent organizes crews to handle the cargo. The longshore union also employs men to check quantities and the condition of incoming and outgoing freight and time-keepers who record the number of hours worked by union members during a specified time period.

Education

Many of the harbor maintenance, longshoring and land-based harbor maintenance jobs require no formal education. Classroom training for these occupations is minimal. Training is carried out on the job. Stevedore training is becoming more rigorous with new cargo-handling equipment.

A majority of the Corps of Engineers harbor activities, on the other hand, require some education, either formal or through a structured apprenticeship-type program. Supervisory personnel are generally college graduates.

Employment Outlook

Employment outlooks for longshoring occupations in recent years have decreased considerably. Freight that was once loaded by hand with large crews of men is now loaded at the factory in containers (cargo units that fit on large truck trailers) and later hoisted aboard ships with a crane.

Employment in land-based harbor maintenance activities and Corps of Engineers projects has remained relatively constant in past years and shows few signs of increasing or decreasing in future years.

Occupations for Harbor Maintenance and Activities

Harbor Maintenance (Corps of Engineers)

SUPERVISING CIVIL ENGINEER (See D.O.T.--005.081): The supervising civil engineer of an area office is responsible for all harbor and maintenance activities conducted within his jurisdiction. As chief of harbor maintenance, the supervising civil engineer determines conditions of navigation facilities or maintenance dredging projects, estimates their costs and submits these proposals to the district office (Galveston) for approval. Upon approval of the district engineer, the area engineer draws up final plans and specifications describing the type and scope of work to be done. Bids are then let to contractors on a low-bid basis. The district engineer is the contracting officer for the proposed work. The area engineer is responsible for inspection and approval of completed work at the end of a project; he usually holds a bachelor's degree and reaches this position with a minimum of five years' experience as a civil engineer. In most cases he is a registered professional engineer.

CIVIL ENGINEER (See D.O.T.--005.081): A civil engineer, often called the project engineer, performs a variety of engineering work; he plans, designs and oversees construction and maintenance work in and around a specific harbor area or project. The civil engineer also supervises field survey parties and maintains an accurate and up-to-date set of topographical maps indicating the depth, contour and other characteristics of the harbor area. He is also responsible for preparing plans for required maintenance and construction projects and for inspecting these projects. A civil engineer

normally holds a bachelor's degree and reaches this position after a rotational training program and after line assignments in the civil engineering discipline under close supervision of a professional engineer.

CIVIL ENGINEERING TECHNICIAN (See D.O.T.--005.): A civil engineering technician works closely with a civil engineer as an assistant in planning, designing and overseeing the construction and maintenance of various harbor and harbor-related projects. He is not a licensed professional engineer, does not hold an engineering degree and does not possess the professional experience of a civil engineer. He usually reaches this position through a two- or four-year technical degree or by gaining on-the-job experience as a draftsman, surveying technician or construction inspector for a number of years, or by a combination of education and experience.

CIVIL ENGINEERING TECHNICIAN (DRAFTSMAN) (See D.O.T.--005.281): A civil engineering draftsman lays out, details and maintains a set of topographical maps of the harbor area. He will be called upon to draw and detail documents (drawings and specifications) for proposed construction and maintenance projects. The civil engineering draftsman may reach this position through a two- or four-year drafting or civil technology degree, through experience gained as a surveying technician in some related area of civil drafting work or by a combination of education and experience.

SURVEYING TECHNICIAN (See D.O.T.--018.188): A surveying technician surveys harbors and shorelines to determine water depths and to establish or to maintain reference points. Surveys indicate whether or not channels and harbors are deep enough for navigation. This technician operates various sounding and depth-measuring equipment to determine the water depth at various locations; he also employs topographic surveying devices. This information is recorded and submitted to the engineering and drafting staff, who prepare hydrographic and topographic maps.

CONSTRUCTION INSPECTOR (See D.O.T.--182.287): This inspector oversees construction activities to ensure that materials, methods and procedures comply with plans and specifications. He keeps a job progress log, maintains quantity records for pay purposes and reports this information to the field office regularly. The construction inspector may suggest alternate procedures when field conditions disagree with contract plans. The inspector usually reaches this position after several years' construction, operation and repair experience as operator, skilled tradesman, craft supervisor, etc. The experienced construction inspector is able to read plans and specifications and is thoroughly acquainted with construction materials, procedures and safety requirements.

SURVEYING AIDE (See D.O.T.--018.): A surveying aide assists the surveying technician with sounding and depth measuring equipment. He must be able to use the level, transit, rod and chain. The aide may be called upon to chart information regarding topographic location and data. He usually has a high school education and may advance to the position of surveying or engineering technician after several years of experience and study of mathematics.

SURVEY BOAT OPERATOR (See D.O.T.--018.): A survey boat operator maneuvers the boat carrying sound equipment and personnel around the harbor. The operator is able to read navigation charts and to determine the exact location where soundings should be made. He operates the vessel in accordance with U.S. Coast Guard requirements and is required to possess a pertinent license issued by the U.S. Coast Guard.

Land-based Activities

FOREMAN (CONSTRUCTION AND MAINTENANCE) (See D.O.T.--869.138): The construction foreman supervises and coordinates the work done by mechanics, laborers, pile drivers, blacksmiths, electricians, truck drivers and any other occupation for which he is responsible in repairing and maintaining the shipyard. A foreman has a working knowledge of the above-mentioned crafts and can supervise and coordinate these activities among employees. A foreman rises to this position through many years' experience in one or more of the above-mentioned crafts.

LEAD MECHANIC (See D.O.T.--860.131): This individual is a carpenter who coordinates the activities of workers engaged in construction, installation and repair of wooden structures. A lead mechanic is familiar with the techniques of carpentry, layout and fabrication of equipment; he can read blueprints and specifications, inspect completed work, select materials and perform simple mathematical calculations. A lead mechanic usually rises to this position through experience as a mechanic and mechanic's helper.

MECHANIC (See D.O.T.--860.131): A mechanic is a carpenter who builds, repairs and maintains wooden structures. He is familiar with laying out of materials, use of carpenter's tools and equipment; and he can perform simple mathematical calculations. A mechanic usually arrives at this position through experience as a mechanic's helper.

MECHANIC'S HELPER (See D.O.T.--860.887): This person assists the mechanic (carpenter) in repairing equipment and structural woodwork of buildings. He is instructed in his work activities by a mechanic or lead mechanic. A mechanic's helper reaches this position through promotion from the rank of laborer.

LEAD AUTOMOBILE MECHANIC (See D.O.T.--620.): This employee directs the activities of mechanics and mechanic's helpers. The lead mechanic is responsible for inventory of replacement parts, inspecting work and diagnosing malfunctions. He attains this position after many years of experience as an assistant automotive mechanic, and/or he may attend a vocational training program.

AUTOMOTIVE MECHANIC (See D.O.T.--620.281): This mechanic analyzes, repairs, overhauls and services gasoline-powered equipment, which may include trucks, automobiles, forklifts and backhoes. An automotive mechanic has manual dexterity and an in-depth understanding of carburation, electrical and transmission systems. He usually reaches his position through experience gained as an automotive mechanic's helper.

LABORER (See D.O.T.--809.887): A laborer loads trucks, washes vehicles, sorts metal and scrap material, carries materials to and from the work site, operates forklifts and material-handling equipment and assists workers in various duties. This position is entry-level in rank, requiring only good physical condition. Laborers, through experience, advance to the rank of craftsman or semiskilled worker.

RAILROAD-HOIST OPERATOR (See D.O.T.--921.883): The railroad-hoist operator maneuvers a crane that travels on railroad tracks to lift, move and position heavy objects. The operator is also responsible for minor crane maintenance and inspects the crane for wear and possible malfunction.

CONTAINER-CRANE OPERATOR (See D.O.T.--921.): A container-crane operator maneuvers a large crane positioned on tracks that transfers semitruck container cargo units to/from the truck bed from/to the ship's hold during loading. The container-crane operator attains this position through experience as an assistant crane operator.

PILE DRIVER (See D.O.T.--859.782): A pile driver manipulates a derrick-like rig mounted on a barge with a drop hammer; the rig pounds piling (either wooden posts or sheet metal) into the ground above or below water level to the required depth. This person is also responsible for maintaining and lubricating the rig. The position of pile driver is usually achieved after several years of experience as a pile driver's helper.

DIESEL ELECTRICIAN (See D.O.T.--825.281): A diesel electrician repairs and services the electrical circuitry of diesel equipment, which is used to pull rail cars to and from the harbor area. His responsibilities include repairing and replacing motors, generators, air conditioning units, outlets, lighting fixtures, gauges and ignition components. The diesel electrician usually has some formal electrical training, although many electricians reach this position after working as an apprentice for a number of years.

MAINTENANCE ELECTRICIAN (See D.O.T.--824.281): A maintenance electrician repairs, installs, replaces and tests such electrical components as control devices, fixtures, switches, junction boxes and electrical wiring. He can read and follow blueprints and specifications, use portable power equipment, do simple mathematical calculations and use various pieces of test equipment to check current flow and to troubleshoot electrical equipment. A maintenance electrician usually arrives at this position after several years of experience as an apprentice electrician or electrician's helper.

MATERIAL YARDMAN (See D.O.T.--919.): A material yardman loads, unloads and conveys materials within or near the plant. He opens containers, loads pallets, weighs materials and records units of materials on a production sheet.

BACKHOE OPERATOR (See D.O.T.--850.883): A backhoe operator maneuvers a power shovel, usually mounted on the back of a tractor, to excavate dirt and gravel from trenches, culverts and ditches. He is also responsible for maintaining and lubricating this equipment.

Loading/Unloading Occupation (Harbor)

LONGSHOREMAN (See D.O.T.--922.887): A longshoreman operates such material-handling equipment as the power winch, grain trimmer, crane and lift truck (forklift) to transfer cargo from the dock to the ship's hold or vice versa. He may fasten hose lines to the ship tanks when transferring liquid cargo. Longshore skills are usually acquired through experience; but recent technological improvements in harbor loading/unloading activities, such as containerization of freight and barge containers, have reduced the number of longshoremen's unions that limit employment according to supply and demand.

GANG FOREMAN (HEADER) (See D.O.T.--911.138): A gang foreman supervises and coordinates the activities of longshoremen unloading or loading the cargo of a ship. He assigns duties to workers, supervises the placement of hoisting equipment and determines handling requirements for various cargo types. A gang foreman usually reaches his position after working as a longshoreman for a number of years and by exhibiting responsible leadership abilities.

SPOUT-TENDER FOREMAN (See D.O.T.--929.887): A spout-tender foreman supervises the transfer of grain and cargo to and from the ship's hold and the storage bins at the elevator. He also determines the volume or weight of grain discharged. A spout-tender foreman attains this position after several years' experience as a spout tender.

SPOUT TENDER (See D.O.T.--929.887): This person regulates the transfer and flow of materials from the ship's hold to storage hoppers and grain elevators that are usually near the wharf. The spout tender is also responsible for raising and lowering spouts that transfer the grain from elevators into the ship's hold or trimming machine hopper.

LIGHTMAN (See D.O.T.--): A lightman positions, operates and maintains floodlights around and in the ship's hold when cargo is being loaded and unloaded.

GRAIN TRIMMER (See D.O.T.--781.): This employee shovels grain into the hold of a ship when mechanical trimmers are not used. Since a large majority of grain is now mechanically unloaded from the ship, fewer grain trimmers are employed.

SWITCHMAN (See D.O.T.--910.884): A switchman operates track controls to maneuver loaded and empty railroad cars to and from the wharf area to various yard locations. The switchman may also receive written instructions to direct various cars to a particular location in the wharf area.

SECURING MAN (See D.O.T.--): He utilizes bands, wood, wire and other materials to prevent cargo from shifting in the ship's hold.

CARPENTER (See D.O.T.--860.381): A carpenter prepares bins and storage areas in the hold of the ship to receive grain and other cargo.

CLEANING CREW (See D.O.T.--381.887): A cleaning crew boards the ship after unloading. The crew sweeps dirt and removes securing bands, wooden supports, wires, shoring and other debris from the ship's hold.

CLERK (See D.O.T.--219.388): A clerk compiles and types the ship's manifest for use at custom houses or terminals; he also verifies the accuracy of the manifest. This work is normally performed in the steamship agent's office.

CHECKER (See D.O.T.--223.387): A checker compiles records of the cargo loaded and unloaded from the ship. He verifies the amount of cargo against the shipping manifest, determines the condition of damaged cargo and on occasion constructs a storage plan for cargo aboard ship.

TIMEKEEPER (See D.O.T.--219.338): Timekeepers record the daily arrival and departure of employees. He tallies the total number of working hours accumulated by each employee during a particular pay period and sends these figures to the payroll department.

Dredging Occupations

SUPERINTENDENT (See D.O.T.--197.): The dredge-barge superintendent oversees all activities of crewmen aboard his barge. He is responsible for overall barge performance and is in charge of any shore operation. He represents the company in all business matters pertaining to dredging operations.

DECK CAPTAIN (See D.O.T.--197.): This person acts as foreman on the barge. Working under the superintendent, he is responsible for onboard discipline and delegates barge job assignments.

CIVIL ENGINEER (See D.O.T.--005.081): The civil engineer plans and oversees channel dredging. After soundings to determine channel depth, he computes the amount of material to be removed from the channel bottom and decides upon the locations to be dredged.

ASSISTANT CHIEF ENGINEER (See D.O.T.--197.): The assistant chief engineer is responsible for the maintaining and repairing all mechanical dredging equipment aboard the barge. He is a day-worker who sees that the pumps and the diesel equipment driving the dredge pumps are working properly. He may either repair defective or malfunctioning equipment or supervise such work.

WATCH ENGINEER (See D.O.T.--197.): This engineer works under the assistant chief engineer. He stands a "watch" and checks to see that mechanical equipment onboard functions correctly. He reports malfunctions to the assistant chief engineer and aids in the repair.

BOAT CAPTAIN (See D.O.T.--197.): The boat captain is in charge of a tug boat that positions the dredge-barge. He oversees activities of all crewmen on his boat. In addition to barge placement, the boat captain may also position pipe flotation pontoons.

DECKHAND (See D.O.T.--552.887): A deckhand washes dredge barge decks, performs routine upkeep duties and ties the barge to wharves or other vessels with mooring lines. The deckhand performs entry-level duties and may work into other positions as his experience increases. When needed, he also serves as a dumpman.

RODMAN (See D.O.T.--801.): Using a pole divided in uniform increments, the rodman takes soundings of the harbor or channel. He records various water depths; from this information, the amount and position of excess channel bottom material can be determined.

OILER (See D.O.T.--669.887): The oiler lubricates the moving parts of mechanical equipment onboard the dredge barge by applying oil or grease from cups or guns to friction surfaces. If he discovers any defect or malfunction, the oiler reports to his supervisor. He also performs the engineering duties under the engineer's supervision.

GALLEY CREW (See D.O.T.--): The galley crew prepares food for crewmen aboard the dredge-barge. In addition to preparing meat, vegetables, breads and pastries, they clean the galley and dining areas of the barge.

LEVER MAN (See D.O.T.--): The lever man operates controls that raise and lower the dredging equipment used to clean silt from harbor bottoms. He watches gauges to insure the proper operation of the pump and raises or lowers the "stinger" to maximize the dredging operation.

DUMPMAN (See D.O.T.--): The dumpman lays pipe to facilitate proper water drainage from silt behind levees. He observes the drainage to ensure that no polluted water passes through the spill boxes and returns to the harbor. The dumpman also serves as a deckhand when needed.

LABORER (See D.O.T.--850.887): The laborer ensures that the dredge discharge pipe remains clear of silt. He may also level the silt and help to move the position of the discharge pipe.

MARINE RECREATION AND TOURISM

Introduction

Increasing urbanization, leisure time, mobility and increased income have stimulated a major role for marine recreation and tourism activities in the Texas economy. The influence of the Texas marine environment extends along the Gulf Coast and far into the midsection of the United States (Miloy and Copp, 1970, p. 107).

Marine recreation and tourism activities constitute a vital part of the economic base of virtually all major urban and medium-sized communities along the Texas coast. The development of coastal recreation-oriented communities has absorbed most of the Gulf Coast recreational demand generated by the population concentrations in the southern half of Texas (Miloy and Copp, 1970, p. 107).

The marine-related attractions along the Texas coast are highly diversified. Texas has 1,081 miles of shoreline and more than 301 miles of beach shoreline. The remainder of the coastal margin is bluff shore, 421 miles; marsh shore, 359 miles; public recreation areas, 5 miles; and restricted shore areas, 18 miles (Miloy and Copp, 1970, p. 109). In addition, Texas has almost continuous offshore barrier islands paralleling the mainland shore. These barrier islands include Padre Island, Matagorda Island, Matagorda Peninsula and St. Joseph's Island. Padre Island extends for 113 miles and is the longest barrier island in North America (Berryhill, 1970, p. 17). Eighty miles of this island is used as national seashore. With the exception of the Brazos Delta, the mainland is separated from the barrier islands by shallow coastal lagoons that vary in width from three to six miles (The Report of the United States Study Commission -- Texas, Part II, 1962, p. 121). The coastal beaches, bays, estuaries, shallow coastal lagoons and deeper Gulf of Mexico waters constitute major attractions along the Texas coast. Texas bays, attractive for sportfishing, include Galveston, Matagorda, San Antonio, Espirito, Capano, Lavaca, Aransas, Nueces, Corpus Christi, Baffin and Laguna Madre (The Report of the United States Study Commission -- Texas, Part II, 1962, p. 121). Varieties of sportfish along the Texas coast include redfish, flounder, speckled trout and black drum.

The Texas coast is also prominent among coastal areas of the United States as a wintering ground for migratory birdlife. There are more than 1.8 million acres of wetlands in the Gulf coastal area. Most of the wetlands above Matagorda Bay to Louisiana are marshes while the remaining wetlands are mostly sounds and bays containing water less than three feet deep. These areas of the Gulf Coast region constitute more than 60 percent of the waterfowl habitat of the state. About 61 percent of the ducks and 80 percent of the geese wintering in the United States remain in these regions (The Report of the United States Study Commission -- Texas, Part II, 1962, p. 121).

Several national wildlife refuges are also located along the Texas coast. The Aransas National Wildlife Refuge is a seasonal sanctuary for many birds, including the rare whooping crane. Coastal areas under state supervision include Velasco, Brazos Island, Indionola, Port Isabel, Goose Island and Mud Island state parks. A portion of Galveston Island has also been purchased recently for a state park facility. State-owned coastal lands -- beach areas, islands in coastal waters, lands beneath the bays, inlets and other inland waters -- total more than 1.5 million acres.

Types of Activities

Marine recreation and tourism activities are unique in that they are resource-based activities. Other types of outdoor recreation have been classified as user-oriented and intermediate recreation areas. User-oriented areas are similar to city parks or playgrounds; they are readily accessible to users. Intermediate areas are like state parks or federal reservoirs; they are within short distance of urban areas and usually are smaller than typical resource-based areas (Clawson and Knetsch, 1966, p. 37-38). Both state and federal agencies operate parks and beaches.

Operators of beach hotels, motels, marinas, tourist cabins, bath houses and restaurants and the developers of coastal real estate exist because of the scale of marine recreation and tourism activities along the coast. Mobile home, pleasure boat and related-business dealers depend to some extent upon the attraction of the marine environment for their volume of activity.

THE MERCHANT MARINE INDUSTRY

Introduction

The United States Merchant Marine operates out of nearly 70 ports located along the Atlantic, Gulf and Pacific coast shorelines. Presently, approximately seven out of eight merchant marine ships in operation are privately owned. The government-owned ships are operated by the Navy's Military Sealift Command (MSC), which has civilian personnel working aboard the ships (Occupational Outlook Handbook, 1972, p. 741).

In 1970 the United States Merchant Marine Fleet consisted of about 770 ships, of which approximately 255 were tankers, 500 were freighters, and 10 were combination passenger/mail/cargo-carrying ships. Ninety percent of the 42,000 employed seamen were serving aboard tankers and freighters at that time (Occupational Outlook Handbook, 1972, p. 741).

Except for the purser and radio operator, men are employed at work aboard ship in the engine, deck or steward's departments.

Employees of the engineering department operate, maintain and repair the propulsion and auxiliary systems of the ship. Occupations in this department range from a chief engineer, who functions in a supervisory capacity, and the assistant engineer, who stands watches, to electricians, oilers, wipers and firemen, who are responsible for routine maintenance and repair work. The deck department assumes responsibility for navigating the ship, loading and unloading cargo and maintaining deck equipment. Deck officers include the first mate, second mate and third mate who stand bridge watches and act in supervisory capacities similar to engineers in the engine department. Other deck occupations include boatswain, able seaman, ordinary seaman, deck utilityman and ship's carpenter. These men perform maintenance and repair duties on the ship's deck.

The steward's department cleans the living quarters of the ship and feeds the crew. Under the direction of the master (captain), the chief steward determines the responsibilities of the steward's department.

All members of a ship's crew, including the master (captain), have organized labor unions (an exception may be company unions on the tankers). Union halls, located at every major seaport, supply ships with necessary crew members and enforce provisions of the agreements. Through collective bargaining unions also negotiate with shipowners to improve working conditions, wages and other employee benefits. Table III lists a breakdown of maritime labor unions and includes the occupations that these unions represent.

Education

In the past training and advancement in the merchant marine was acquired through an apprenticeship-type program. A young man entered the merchant marine as a deck utilityman or an "ordinary" seaman in the deck department, as a wiper in the engine department or as cook's or steward's helper in the steward's department. After he gained experience about his position as well as knowledge about the sea, he advanced through the ranks.

TABLE III

LABOR ORGANIZATION AND MEMBERSHIP

Labor Organization	Membership
International Organization of Masters, Mates, and Pilots (M.M.P.) Associated Maritime Officers (M.E.B.A.) Brotherhood of Marine Officers (B.M.O.) Tanker Officers Assn. (M.E.B.A.)	Master (Captain) and licensed deck officers
National Maritime Union of America (N.M.U.) Seafarers International Union of North America (S.I.U.)	All unlicensed members in the deck department, engine department and steward's department
National Maritime Engineer's Beneficial Association (M.E.B.A.)	Licensed engine officers
American Radio Association (A.R.A.) Radio Officers Union	Radio operators

Many licensed officers in the deck and engine departments prepared for licensing examinations through this type of self-study program. In addition to self-study, various labor organizations have established training centers to upgrade their members' educations and to keep them abreast of new innovations in ship navigation and propulsion. For example, the Marine Engineers Beneficial Association owns and operates a training school in Baltimore, Maryland to which union members are admitted free. Courses offered include marine electronics, power systems and instrumentation for automated vessels.

In addition to advancement "through the ranks," training can also be obtained from the United States Merchant Marine Academy at Kings Point, New York; five state merchant marine academies (including the Texas Maritime Academy in Galveston); the United States Coast Guard Academy; or one of several junior college programs that have been developed recently. Few academy graduates, however, make the sea a life-long career. Many graduates secure land-based employment after gaining a few years of maritime experience.

Eligibility

In order to work aboard a merchant marine ship, one must obtain a set of working papers from the U.S. Coast Guard. To secure these papers, the applicant must be a U.S. citizen, prove that he has been offered employment aboard a merchant marine ship and pass a written and physical examination. Men eligible for deck and engine officers' positions must also pass a license-qualifying examination. In addition, crew members must pass a Coast Guard physical examination at prescribed intervals.

Employment Outlook

Present employment prospects in the merchant marine are limited. The United States Merchant Marine Fleet has decreased in size considerably over the past decade. Table IV shows the decrease in size of the merchant marine fleet and personnel during the two-year period 1968-70. These figures represent a reduction of approximately 330 ships in two years.

TABLE IV

TOTAL REPRESENTATION OF THE UNITED STATES MERCHANT MARINE FLEET FOR 1968 AND 1970

Year	Freighters	Tankers	Passenger Cargo Ships	Total	Ship Personnel
1968[a]	810	270	26	1,106	60,000
1970[b]	505	255	10	770	42,000

Sources: [a]U.S. Department of Labor, Bureau of Labor Statistics, Occupational Outlook Handbook, 1968 Edition (Washington, D.C.: Government Printing Office, Bulletin 1700, 1972) p. 721.

[b]Ibid. 1972-73 Edition, p. 741.

In 1968 one out of three merchant marine ships was government-owned; whereas, in 1970 one out of eight was owned and operated by the government, thus showing a significant decrease in the number of government-owned ships in the U.S. fleet (Occupational Outlook Handbook, 1972, p. 741).

In addition to those ships operated directly by the U.S. government, the total number of additional ships on government charter or contract also decreased.

Many reasons account for the constantly decreasing size of the U.S. merchant marine fleet. Since merchant marine trade is highly competitive among nations, a few of the factors for limited U.S. involvement include: (1) foreign shipbuilding costs are much lower, enabling foreign merchant fleets to transport cargo at lower rates; (2) foreign crewmen and ship repair workers are employed at a lower pay-rate, which again enables foreign shipowners to transport cargo at lower rates; (3) United States government subsidies to shipping companies have been constantly decreasing; and (4) the higher wages paid United States union members have not been enough to provide quality. These decreasing subsidies, coupled with increasing world competition, signaled the financial demise of several private American shipping companies.

Since World War II the United States Merchant Marine Fleet has constantly declined. In the late 1940's the U.S. merchant fleet was a world leader -- today it is low on the list when compared to such world leaders as Japan, the U.S.S.R. and Norwegian countries. The Merchant Marine Act of 1970, in addition to other favorable factors, has brightened the future outlook for growth of the U.S. Merchant Marine Fleet. This needed federal subsidization could help the United States return to a position of world power in the merchant marine.

General Information

Work aboard ship is conducted in one of two ways -- watch-standing or day work. Day workers are employed on a standard eight-hour shift similar to that of most land-based occupations. On the other hand, watchstanders work two four-hour watches per day with eight hours off between each watch.

Salaries, including overtime pay, vary according to ship size but in 1970 generally ranged from $800 per month for seaman and related positions to $1100 and up per month for a ship's officers (Occupational Outlook Handbook, 1972, p. 742). In addition, officers and crewmen usually earn an additional 50 percent of their base pay in overtime while at sea. Paid vacations range from 60-100 days per year; comprehensive medical, welfare and retirement benefits

are available to all employees. A man can retire from the merchant marine after twenty years service but few personnel serve that long. (Occupational Outlook Handbook, 1972, p. 742). Many licensed officers and merchant marine graduates work at sea for a few years and then move on to land-based occupations in education or industry.

Descriptions of merchant marine occupations are given below.

Occupations for the Merchant Marine

General Officers

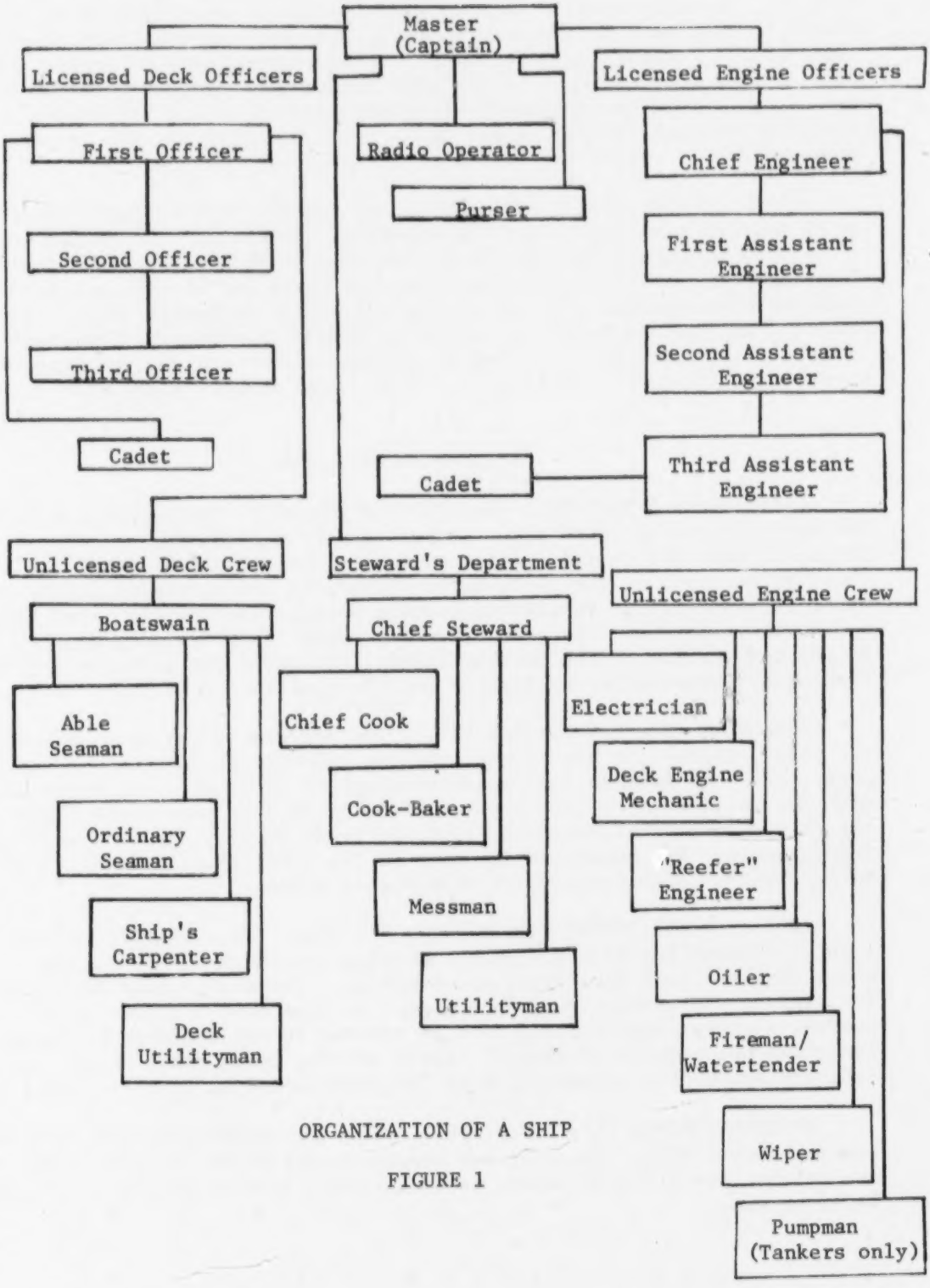
CAPTAIN OR MASTER (See D.O.T.--197.168): Responsible for the operation of the ship, he supervises the deck, engine and steward's crews, as well as the radio operator. He sets the course of the ship and maintains the ship's log. The master is the ship's agent and deals with customs officials when the vessel is in a foreign port. He serves as paymaster of the ship if a purser is not aboard. Always promoted from the deck department, the captain is licensed by the Coast Guard according to the size and type of ship he commands. Although formal education is not mandatory, advancement to a captain's position on some modern and automated ships can be obtained more easily with formal schooling at a merchant marine academy.

RADIO OPERATOR (See D.O.T.--193.282): The radio officer is licensed by the Federal Communications Commission as well as by the U.S. Coast Guard. He operates, maintains and repairs the radiotelegraph and accessories aboard ship. In addition to these duties, the radio officer maintains a log of messages transmitted and received, time signals and weather position reports. He also monitors emergency frequencies for ship and distress calls.

PURSER (See D.O.T.--197.168): The purser supervises those activities related to shipboard business functions. He maintains payroll records, pays crew wages and prepares the ship's entrance and clearance papers for visiting foreign ports. When discharging cargo in port, the purser checks the cargo manifest and supervises the storage and removal of baggage. On some ships the purser may act as pharmacist mate. On ships or companies lacking this position, these duties are performed according to the Master's direction.

Licensed Deck Officers

FIRST OR CHIEF OFFICER (See D.O.T.--197.133): A Coast Guard licensed ship officer, the chief mate, is second-in-command to the captain. In this capacity he assigns duties to the deck department crew and maintains order and discipline on board. In addition, he plans and oversees loading, unloading and storage of the ship's cargo. He also aids the captain in directing the ship in and out of ports. In some instances, the first mate may be trained to handle minor medical problems aboard ship. The position of chief mate may be attained by upward movement through the crew or by formal training received at a merchant marine academy.



ORGANIZATION OF A SHIP

FIGURE 1

SECOND OFFICER (See D.O.T.--197.133): The second mate is the navigation officer. In this capacity he sees that the vessel is equipped with the necessary navigational charts and equipment and that the equipment is properly maintained. Although it is possible for the second mate to attain this rank through formal education at a maritime academy, he usually acquires this position after fulfilling necessary experience and licensing requirements and advancing through the unlicensed deck crew. In addition, the second mate must have previously served as third mate for at least one year.

THIRD OFFICER (See D.O.T.--197.133): As the ship's signal officer, the third mate is responsible for all signaling equipment. Care and maintenance of the navigating bridge and chart room are his supervision. He assists the first mate in supervising the loading, unloading and storage of cargo. The third mate may inspect all lifesaving and safety equipment aboard ship to ensure that such equipment is usable in time of emergency. This rank can be reached through formal schooling or through experience and the appropriate Coast Guard licensing examination. Most large vessels carry two third mates.

Unlicensed Deck Crew

CADET (DECK DEPARTMENT) (See D.O.T.--911.133): This cadet is apprenticed for the position of third mate. Supervised by a deck officer, the cadet performs all deck and navigational duties to prepare for his future position. These duties include the observation of loading and unloading operations in order to learn proper on-and-off loading storage procedures. When standing watch, the cadet may supervise crewmen engaged in maintaining deck equipment. At the termination of his apprenticeship, the cadet may pass the appropriate Coast Guard examination to qualify for the position of third mate.

BOATSWAIN (See D.O.T.--911.131): The boatswain, who works directly under the chief officer, is the highest ranking, non-licensed member of the deck department. As foreman (non-watchstanding) of the deck crew, he works closely with the chief mate to direct the activities of deck crew members and to supervise the deck crew in repairing deck equipment as well as in docking and mooring the ship. His immediate superior is the first mate. The boatswain is certified by the Coast Guard as an Able Bodied Seaman.

ABLE (BODIED) SEAMAN (See D.O.T.--911.884): This skilled worker is experienced in handling deck equipment, manning the wheel on the bridge and all other duties except navigating and piloting. The able seaman is responsible for rigging and stowing cargo and gear. He must have a knowledge of fire safety, signals, knotting and must be trained in all operations connected with launching and manning lifeboats. After serving three years aboard ship, the ordinary seaman can be certified by the Coast Guard as an Able Bodied Seaman.

ORDINARY SEAMAN (See D.O.T.--911.887): The ordinary seaman acts as a laborer aboard ship. The ordinary seaman scrubs decks, splices ropes, chips and paints. An ordinary seaman is occasionally called upon to steer the ship while at sea.

SHIP'S CARPENTER (See D.O.T.--860.281): The carpenter is responsible for repairing and maintaining the ship's anchor and winch. In addition, he helps to shore or brace cargo and acts as general maintenance man of the ship.

DECK UTILITYMAN (See D.O.T.--911.884): The deck utilityman is Coast Guard certified as an able seaman who may stand watch in times of emergency.

Licensed Engine Officers

CHIEF ENGINEER (DAY WORKER) (See D.O.T.--197.130): In charge of the engineering department, this individual oversees operations of the power plant and mechanical equipment. The chief engineer is responsible for the log of equipment and supplies used in the engine department, as well as for maintaining and operating engines, boilers, deck machinery, electrical, refrigeration and other related mechanical equipment aboard ship. He is licensed by the Coast Guard according to the type of propulsion system he oversees (i.e., steam, motor or nuclear vessels). A member of the engineering department can attain this position through apprenticeship or through training at a merchant marine academy.

FIRST ASSISTANT ENGINEER (DAY WORKER) See D.O.T.--197.130): The first assistant engineer supervises activities associated with starting, stopping and speed control of the ship. In addition, the first assistant engineer oversees the maintenance and repair of all engines, motors and generators aboard ship. He may have received formal education at a merchant marine academy or he may have been promoted through the ranks. In order to qualify for the appropriate examination, the first assistant engineer must have one year's experience as a second assistant engineer.

SECOND ASSISTANT ENGINEER (WATCHSTANDER, USUALLY 4 to 8) (See D.O.T.--197.130): When standing watch, this engineer is responsible for boiler maintenance and operation of all associated boiler equipment. In order to qualify for his license, the second assistant engineer must have one year's experience as a watch-standby third assistant engineer. Although it is recommended that this individual be educated at a maritime academy, he may advance to this position through the ranks.

THIRD ASSISTANT ENGINEER (See D.O.T.--197.130): This individual has responsibilities similar to those of his superior, the second assistant engineer. The third assistant engineer oversees maintenance of the lubrication and engine auxiliary systems (such as the evaporator used to convert sea water to potable drinking water). He may also be responsible for electrical and refrigeration systems aboard ship. If the potential assistant engineer is a graduate of a maritime academy, he may apply for this position after acquiring a year's experience as a cadet. The third assistant engineer does not have to receive a formal maritime education since he may be promoted through the ranks of unlicensed engine room personnel after he passes the required licensing examination.

Unlicensed Engine Crew

CADET (ENGINEERING DEPARTMENT) (See D.O.T.--197.130): The cadet is apprenticed for the position of third assistant engineer. Wnen standing his watch, the cadet performs all duties concerned with operating and repairing the ship's propulsion system and all auxiliary machinery under the supervision of the chief and first assistant engineers. After one year of experience and successfully passing required Coast Guard examinations, the cadet advances to the rank of third assistant engineer.

ELECTRICIAN (See D.O.T.--825.281): A ship's electrician maintains and services such electrical equipment as winches, generators, motors and motor controls, lights, fuses, etc. aboard ship.

DECK ENGINE MECHANIC (See D.O.T.--625): A deck engine mechanic performs many duties executed by the oiler, wiper, reefer engineer or fireman/water tender. On a vessel carrying refrigerated cargo, he may also repair faulty plumbing and defective equipment.

REFRIGERATION ("REEFER") ENGINEER (See D.O.T.--950.782): The reefer engineer maintains refrigeration equipment on a ship that carries perishable goods. He starts, stops and monitors equipment at a suitable refrigeration temperature. The reefer engineer also supervises the repair and upkeep of air conditioning.

OILER (See D.O.T.--911.884): The oiler lubricates moving parts of all mechanical equipment aboard ship. He may also inspect this equipment to see that it functions properly.

FIREMAN/WATERTENDER (See D.O.T.--951.885): A fireman/watertender checks and maintains boilers, burners and other steam pressure equipment in the engine room.

WIPER (See D.O.T.--669.887): A wiper cleans equipment in the engine room and is usually hired aboard the ship at the entry-level with experience at sea.

PUMPMAN (See D.O.T.--549): The pumpman operates and regulates equipment that pumps liquids in and out of storage containers in a tanker.

Unlicensed Steward's Department

CHIEF STEWARD (See D.O.T.--350.138): The chief steward oversees the operation and upkeep of crews', officers' and passengers' quarters aboard cargo and passenger ships. He collaborates on menus with the chief cook on cargo vessels or with the chief chef on passenger ships. The chief steward requisitions all food products and supervises the activities of employees affiliated with the steward's department.

CHIEF COOK (See D.O.T.--315.131): On cargo vessels the chief cook oversees the preparation of food for the crew and officers. He determines the

time and sequence of various cooking operations to ensure that the meal is ready at the appointed time. Inspecting the galley and its equipment, as well as directing galley personnel in sanitation practices are also responsibilities of the chief cook. The chief cook works with the chief steward to prepare the ship's menus. On passenger vessels the chef is the chief cook.

COOK-BAKER (See D.O.T.--315.381): The cook-baker prepares breads, cakes, pastries and confections according to recipes that specify measuring, mixing and baking techniques. He also cleans cooking utilities and stoves at the completion of his baking.

MESSMAN (See D.O.T.--350.878): The messman sets eating tables, serves food and cleans tables in the officers' and crews' mess. He also makes beds and cleans sleeping quarters and bathrooms in the officers' quarters. In addition to these duties, the messman may also wash dishes.

UTILITYMAN (See D.O.T.--318.887): The utilityman serves in a position requiring minimal skill. He gathers food supplies from the ship's storerooms and iceboxes, washes and prepares vegetables, washes eating and cooking utensils and cleans the galley.

THE PETROLEUM INDUSTRY

Introduction

In the last half century technology has helped to bring about a major change in world life styles and has produced an especially great impact on United States citizens. With these changes has come the need for greater energy supplies of gas and oil. We have realized that the supply of these natural resources is not limitless; we have had to look for other sources to meet our demands. One important source is the offshore oil and natural gas that lie within the continental shelf. This knowledge has fostered an "offshore revolution" and has created a growing industry.

For many years Texas has been the leading supplier of oil and natural gas resources. The "offshore revolution" has created great interest and many opportunities for industrial expansion along the Texas coast (Miloy and Copp, 1970, p. 39).

Two states bordering the Gulf of Mexico account for almost all marine mining--Texas and Louisiana. Louisiana produces a greater percentage of marine mining activity than does Texas. Gas is the major offshore resource extracted from Texas offshore activities (Miloy and Copp, 1970, p. 47).

Offshore oil and gas production involves exploration, drilling, underwater services, specialized construction activity, specialized marine transportation requirements, highly skilled engineering expertise and many interrelated activities (Miloy and Copp, 1970, p. 44). For the most part, petroleum industry land occupations are identical to those found offshore; there are few exceptions.

Industry Groups

Miloy and Copp (1970) have noted that four general industry groups are identifiable major components of the Texas offshore mineral industry. They are:

A. Marine Exploration - companies involved in geophysical activity to collect seismic information from oil activity.

B. Marine Construction - companies engaged in laying offshore pipelines, fabricating offshore platforms and other offshore structures, installing offshore platforms and other offshore structures, packaging of drilling or production facilities, building mobile drilling units or derrick and pipe-laying barges.

C. Drilling Contractors and Rig Owners - contractors who own offshore drilling equipment (mobile rigs-tenders-fixed platform rigs) or have drilling crews working offshore; oil companies that own their own offshore drilling equipment; inland water drilling contractors who operate inland bay or shallow water (less than 20 feet) marine drilling equipment; offshore workover companies that own or operate workover drilling type rigs.

D. General Marine Services - companies that contract transportation services to the offshore oil industry; companies that provide diving services; companies that own saturation diving systems; companies with submersible work vessels (Miloy and Copp, 1970, p. 54-55).

Education

Many petroleum-related occupations require no formal education. However, a number of specialized occupations, such as geologists, do require at least a bachelor's degree.

Occupations for the Petroleum Industry

Exploration

PETROLEUM GEOLOGIST (See D.O.T.--024.081): The petroleum geologist explores and charts stratigraphic arrangement and composition of the earth in order to locate gas and oil deposits. He studies well logs, analyzes cores and cuttings from well drillings and interprets data obtained by electrical or radioactive well logging and other subsurface surveys in order to identify earth strata. He examines aerial photographs, evaluates results of geophysical prospecting and prepares surface and subsurface maps and diagraphs depicting stratigraphic arrangement and composition of the earth and probable deposits of gas and oil. He recommends acquisition, retention or release of property leases or contracts; estimates oil reserves in proven or prospective fields; and consults with petroleum engineers concerning drilling and production methods. He may direct drilling of shallow exploratory wells.

PALEONTOLOGIST (See D.O.T.--024.081): The paleontologist studies fossilized remains of plants and animals found in geological formations in order to trace evolution and development of past life and to identify geological formations according to nature and chronology. He recovers and assembles fossilized specimens, notes their positions and classifies them according to their botanical or zoological family and probable age. He prepares treatises on finds in order to further scientific study or to provide aid in locating natural resources such as petroleum-bearing formations. He may organize scientific expeditions and supervise removal of fossils from deposits and matrix rock formations. The paleontologist may specialize in the study of plant fossils and be designated a paleobotanist.

GEOPHYSICIST (See D.O.T.--024.081): The geophysicist studies the physical aspects of the earth. Utilizing the principles of physics, mathematics and chemistry, he investigates and measures seismic, gravitational, electrical and magnetic forces affecting the earth. The geophysicist analyzes data obtained in order to estimate composition and structure of the earth's interior and helps to locate petroleum and mineral deposits.

PETROLOGIST (See D.O.T.--024.081): The petrologist investigates composition, structure and history of rock masses forming the earth's crust. He applies findings to such fields of investigation as causes of formations, breaking down and weathering, chemical composition and forms of deposition of sedimentary rocks, methods of eruption and origin and causes of metamorphosis.

SEISMOGRAPH SHOOTER (See D.O.T.--931.381): The seismograph shooter detonates dynamite or other explosive charges in the ocean in order to set up seismic waves. These waves are recorded by seismic instruments and interpreted to reveal subocean floor rock formations that probably contain petroleum deposits. The shooter is responsible for preparing explosives prior to their detonation. He moves, stores and maintains the inventory of high explosives and must be licensed by the federal government for such activity.

Drilling

PETROLEUM ENGINEER (See D.O.T.--010.081): The petroleum engineer devises methods to improve oil or gas well production and determines the need for new or modified tool designs. In addition to studying geological surveys, earth samples and other data, he advises on the type of derrick and drilling equipment for new wells. He oversees drilling operations and offers technical advice in order to achieve satisfactory economical progress. This engineer directs tests on boreholes to determine pressures, temperatures, direction of drilling, strata encountered and other factors. Not only does he recommend and oversee the use of drilling mud and casing cements, but the petroleum engineer also directs gun perforating, squeeze cementing and other special techniques and tools to solve drilling problems. He devises methods for bringing wells into production, for controlling oil or gas flows and for re-establishing these flows by artificial means after they have ceased naturally. He recommends procedures for treating oil to remove sediment and water; in addition, this engineer oversees the maintenance and cleaning of producing wells. After determining the gas-oil ratio of producing wells, he designates the allowable flow of oil or gas to meet proration regulations. He compiles the logs for each well and the production records on flowing wells; he prepares the regular engineering reports and conducts special studies on such subjects as salt-water encroachment and operating equipment. The petroleum engineer may conduct geological and geophysical surveys and, therefore, may be called a petroleum geologist. If his work concerns only natural gas production, he may be designated a gas engineer.

ROTARY DRILLER, MARINE OPERATIONS (See D.O.T.--930.782): This individual specializes in drilling underwater wells from barge-mounted derricks or from platforms. To drill wells, he operates gasoline, diesel or electric draw works. He observes pressure gauges, then adjusts the throttle and levers to control

speed of the rotary table, which rotates the string of tools in boreholes, and to regulate the tool pressure at the bottom of the borehole. Using handtools, powered wrenches and tongs, he connects sections of drill pipe and selects and changes drill bits according to the strata. He pushes levers and brake pedals in order to control draw works that raise/lower the drill pipe and casing into and out of the well. The rotary driller examines slush pump operations to ensure circulation and consistency of mud, the drilling fluid in the well. He examines drilling or core samples from the well bottom to determine the nature of the strata; using special tools attached to the end of the drill pipe or cable, he fishes for and recovers lost or broken bits, casings and drill pipes from the well. The driller records footage drilled, location and nature of strata penetrated and materials used. He caps the well or turns valves to regulate oil outflow from the well. The rotary driller also repairs or replaces defective parts of the machinery.

DERRICKMAN (See D.O.T.--930.782): This person rigs derrick equipment and operates pumps to circulate mud through drill holes. He bolts the crown block to the post at the top of the derrick, strings cables through pulleys and blocks and clamps a holding fixture to the end of the hoisting cable. The derrickman weighs clay and mixes drilling mud, using portable power mixers. He starts pumps, which circulate mud through the drill pipe and borehole in order to cool the drill bit and which flush the drill cuttings. He may clean and oil pulleys, blocks and cables in addition to repairing pumps. Responsible for maintaining consistency of the mud, the derrickman may also fill in for the driller.

MUD ENGINEER (See D.O.T.--010.081): The mud engineer plans mud-sample testing operations. To determine the status of wells being drilled, he consults with the oil-field drilling superintendent and interprets drilling logs. He plans and coordinates the itinerary for the mud-analysis well-logging captain, the mud analysis well-logging operator and other members of field-laboratory crews to obtain maximum utilization of personnel with minimum disruption of drilling operations. He interprets mud-analysis logs obtained by crews for the petroleum geologist and the petroleum engineer.

TOOL PUSHER (See D.O.T.--930.130): The tool pusher is also known as the drilling foreman, drilling-tool foreman or lease foreman. Within an area consisting of one or more well sites, he supervises and coordinates activities of workers drilling oil and gas wells. He directs rig builders to erect, to dismantle and to move drilling rigs; he instructs drilling crews in setting up and in operating power units, draw works (that raise and lower the drill pipe) and other drilling equipment. The tool pusher plans delivery of drilling tools, fuel, water and other supplies to the drill site; he orders the type of drilling bits to be used according to the strata type encountered. He orders maintenance equipment and materials necessary for drilling operations and rig maintenance. He directs workers in missing drilling mud, in circulating mud in the borehole and in the use of drilling mud to prevent blowouts from gas pressure. The drilling foreman also orders installation of the control head, a valve device to control the flow when the well begins producing gas or oil. He may supervise operations to maintain and to regulate the flow of gas or oil at producing wells. In this case his job title is foreman of production. The tool pusher also may supervise drilling shallow boreholes for use in seismic prospecting or to obtain core samples.

ENGINEMAN (See D.O.T.--950.782): The engineman operates gasoline- or diesel-powered generators to furnish electricity for light and power on barges. He fills the fuel tank, starts the engine and adjusts the throttle to provide a constant power flow. He cleans fuel lines, carburetors and air and fuel injectors.

ROUGHNECK (See D.O.T.--930.884): The roughneck performs the following duties: assembles and dismantles oil and gas well-drilling equipment, bolts the pulley block to the top of the derrick frame, unreels the cable and strings it through the block and tackle, bolts and clamps drilling tools to the drill rod, cleans tools and equipment with a solvent and rags. He handles lead tongs, dopes the pipe, stubs the pipe and undertakes general maintenance of drill floor equipment. In addition to handling the chain, he may also handle a set of tongs when he comes out of the hole. The roughneck hands the pipe to the lead tong man, fastens and unfastens the elevators. His job title may also be lead tong man, chainman or piperack man.

ROUSTABOUT (See D.O.T.--869.884): The roustabout assembles and repairs oilfield equipment. He connects tanks and flow lines; does maintenance work such as painting, sandblasting and chipping; helps in loading and unloading boats. The roustabout also moves pipe around the deck and performs other general tasks of the drill floor crew.

Well Operation and Maintenance

LEASE OPERATOR (See D.O.T.--939.782): The lease operator may also be called a field operator. He operates power pumps and auxiliary equipment to produce a natural or artificial flow of oil or gas from wells. The lease operator opens valves 1) to allow oil to flow from wells into storage tanks, 2) to return compressed gas to the bottoms of specified wells to repressure them and to force the oil to the surface. He shuts off wells according to the production schedule and switches the oil flow into unfilled storage tanks. He reads tank gauges and pump meters as well as keeps production records. The lease operator may supervise workers pumping oil from wells and may also repair gas and oil meters and gauges.

GAUGER (See D.O.T.--914.381): He tests and gauges the amount of oil in storage tanks and regulates the flow of oil into pipelines at the wells and marine terminals, following prescribed standards and regulations. Using a calibrated steel tape and conversion tables, he gauges the quantity of oil in storage tanks before and after delivery. The gauger lowers a thermometer into tanks to take a temperature reading and turns the bleeder valves (or lowers the sample container into a tank) to obtain an oil sample. Using a centrifugal tester and calculating results by standard formulas, he tests oil to determine the amount of bottom sediment, water and foreign materials. He records readings and test results and starts pumps. According to delivery schedules, the gauger turns handwheels that open and close valves on pipelines and tanks in order to regulate and to direct the oil flow from and into tanks. He reads automatic gauges at specified time intervals and calculates the flow rate of oil into or out of tanks, as well as determines the amount of oil in the tanks. In addition, he inspects pipelines, valves and flanges to detect

loose connections and leaks; tightens connections with wrenches; greases and oils valves; seals around valves to secure tanks. The gauger may operate pumps, teletype and mobile radio; may clean pumps, machinery and equipment; may issue delivery or receiving tickets; may record meter and pressure readings at gas wells.

CRUDE-OIL TREATER (See D.O.T.--541.782): The crude-oil treater operates chemical, electrical and centrifugal oil-treatment units to remove sediment and water from crude oil before it is transported by pipeline to refineries. He opens valves and starts pumping oil from storage tanks to treating units. He also opens valves to mix specified chemicals with oil, then adjusts controls to heat the mixture to a specified temperature. The crude-oil treater starts centrifugal machines that break up the oil and water emulsions, then drains off the water. He opens the valves and starts the pumps to transfer oil into settling tanks where sediment is precipitated from the oil; he also determines the content of oil specified for pipeline transportation by testing the sample from a gravity or centrifugal separation machine. He pumps treated oil into pipelines leading to the refinery; cleans and lubricates motors, pumps and other moving parts of units; records data such as the volume of oil treated, operation temperatures of units and test results. This employee may pump wells and may remove impurities from the natural gas.

Natural Gas Processing Occupations

DEHYDRATION-PLANT OPERATOR (See D.O.T.--541.782): See Treater or Crude-Oil Treater listed above with description.

OIL WELL CEMENTER (See D.O.T.--930.281): This individual controls cement mixing and pumping equipment to caulk openings in permeable rock formations and in walls or casings of gas or oil wells. He computes the necessary amount of cement and drilling fluid for the well and devises a cementing procedure according to individual well conditions. He directs the oil well cementer helper in mixing cement, starts the automatic pump to force cement into predetermined well sections and lowers measuring and testing devices into the well to verify the location and solidification of the cement. He also reads meters and gauges to control the pump pressure.

OIL WELL CEMENTER HELPER (See D.O.T.--930.884): This helper assists the oil well cementer in controlling the cement mixing and related pumping equipment. He transports equipment to the well site; signals the hoist operator to lower special plug devices into the well to control cement placement; and connects the tubing between the wellhead, pressure pumps and cement supply tank. He dumps specified ingredients, such as dry cement and water, into the mixing tank and starts the mechanical or jet-type mixer. The oil well cement helper also weighs the mixture samples and repairs cementing equipment.

ACIDIZER (See D.O.T.--930.782): By controlling the blending and pumping equipment, the acidizer can treat oil or gas wells with acid in order to increase their production. He consults with the drilling and production superintendents to determine the type and amount of acid, its duration and point of application to the oil- or gas-bearing rock formations. He instructs the

acidizer helper to load premixed acid solutions at the plant or to form acid solutions by blending chemicals at the well site. The acidizer examines drilling logs and cores to determine the tools needed for directing the acid solution flow, connects pipes from the wellhead to truck tanks and starts pumps to force acid into the well and rock formations as well as to flush excess acid from the well. Before treatment he may test the well fluids to determine the effective acids and other chemicals or may send fluid samples to the laboratory for analysis; in addition, he may cement the wells. The acidizer's position may be titled according to the kind of fluid treated (e.g., a water acidizer).

ACIDIZER HELPER (See D.O.T.--939.884): This employee helps the acidizer control the blending and pumping equipment. The helper assembles acid pipes and pipe fittings. He connects the pipe between pumping equipment and wellhead, dumps acids and other chemicals into a mixing device to blend the treating solution and, after a signal from the acidizer, opens a valve to feed the solution into the well. In addition, he dismantles and loads equipment, assists in cementing wells and performs other duties described under Helper.

OIL WELL PERFORATOR OPERATOR (See D.O.T.--931.782): He operates hoisting equipment and the electrical control panel to position and explode charges in oil or gas wells. The explosions fracture earth formations and pierce drill pipes, casings and tubings. The oil well perforator operator assembles tools and equipment at the well site; lowers the perforating gun into the well; observes the odometer, weight indicator and instrument panel; and positions the gun at a predetermined point in the well. He adjusts controls at the panelboard to detonate the gun charge that propels bullets through the bore wall to pierce or fracture oil- or gas-bearing formations. By manipulating controls, he can ignite a chemical charge that will burn fissures in rock formations and create a passage for the oil or processing fluid (e.g., mud or cement). This operator also observes the instrument on the control panel that verifies the detonation of the gun charge. He may repair electrical instruments and may load perforating guns at the well site for special shots.

HEAD WELL PULLER (See D.O.T.--939.131): He supervises and coordinates activities of well pullers. The head well puller may oversee the installation of tubing in new wells and may swab wells to induce the flow of oil. He also performs duties described under Foreman.

WELL PULLER (See D.O.T.--930.883): The well puller controls power hoisting equipment that extracts tubing from oil and gas wells for repair and that lowers repaired equipment, testing devices and servicing tools into the well. He disconnects tubing sections, then runs the packer (a plug device) into the well to control the flow of oil, water or gas during well-pulling operations. With a swabber the puller clears mud from screens at the bottom of the well in order to establish an oil flow. He lowers a pressure-recording device into the well, interprets resulting charts, manipulates special tools that fish for broken tubing. He also scrapes paraffin and incrustations from the casing or tubing, plugs the well with cement and tests the pipe for leaks. The well puller may be designated by title according to the equipment used (e.g., a hydraulic oil-tool operator).

MUD-LOGGING ANALYSIS SUPERINTENDENT (See D.O.T.--010.168): This superintendent coordinates the activities of the mud-logging crew, which analyzes the drilling mud in order to locate oil or gas. He supervises mud-analysis and mud-logging operators when they conduct a continuous sampling, analyze mud circulating through wells being drilled and prepare mud analysis logs. The mud-logging analysis superintendent oversees the analysis of cores cut from wells to determine the nature of penetrated earth formations. He also interprets logs and core analyses for engineering personnel.

MUD-LOGGING ANALYSIS OPERATOR (See D.O.T.--010.281): This operator analyzes mud that is circulated through the oil or gas well boreholes during drilling operations. With special testing equipment he detects the presence of oil or gas and interprets the readings to locate productive stratum. At the well site the operator sets up a field laboratory, mechanical and electrical testing instruments and equipment to provide continuous testing of the mud as it flows from the well. He determines if there is gas in the mud by reading a gas-detection meter that is hooked to tracing devices in the mud. The mud-logging analysis operator inspects mud samples under ultraviolet light to determine the type and quantity of oil present. From his records of dial readings and tests results, he calculates the depth of wells containing gas or oil. In addition to making minor repairs on electrical and mechanical equipment, he also inspects core samples or cuttings from the well to determine the nature of the strata.

RESEARCH AND DEVELOPMENT

Introduction

Marine-related research and development is directed at an interdisciplinary system involving aquatic, atmospheric and terrestrial systems. Professionals whose educational training or experience is not marine oriented often help solve problems with solutions that depend upon their technical expertise. Most job descriptions for land-oriented personnel have their equivalent in marine-related industrial, educational and governmental organizations. Job careers exist for specialists in marine law, in marine commerce, in coastal and ocean engineering, for example.

Four categories for research and development personnel can be considered: (1) basic research and teaching, (2) applied research, (3) management and (4) support. Most job titles listed below represent people working in scientific and engineering disciplines. Although this list is only partial, the titles include many representative descriptions. Positions in research and teaching are filled by professionals working full- or part-time; marine geophysical companies and fisheries often employ these people. University-based professionals, often involved in extensive research, conduct most of the teaching.

As previously mentioned, most land jobs have their equivalent in the marine realm. Numerous research, teaching, management and support personnel have acquired specialized skills in order to deal with the marine environment. In the sections below, references made to business professionals are intended only to cite examples, not to identify new careers. Similarly, jobs that support scientists and engineers are universal; in addition, some of the more recognized marine technician or support positions are cited.

Sources of Funding

Funding sources of marine research and development in Texas are federal departments and agencies, the state legislature, state agencies and private industry. The activities of various federal agencies are listed below.

Department of State.....	Participation in international organizations; support of international fisheries, commissions and marine policies.
Agency for International Development.....	Foreign assistance and food resources for developing nations.
Department of Defense..... (Navy, Advanced Research Projects Agency, Army Corps of Engineers)	All phases of oceanography relating to national security; naval technology; statutory civilian responsibilities; river, harbor, coastal

	and ocean charting and forecasting; Great Lakes, river, harbor and coastal development, restoration and preservation.
Department of the Interior..... (Geological Survey, Bureau of Sport Fisheries and Wildlife, Bureau of Mines, Bureau of Land Management, National Park Service, Bureau of Outdoor Recreation, Office of Saline Water)	Management, conservation and development of marine mineral resources; acquisitions, preservation and development of coastal areas; identification of sources and interrelationships for supply of fresh water.
Department of Commerce..... (National Oceanic and Atmospheric Administration, Maritime Administration)	Management, conservation and development of living marine resources; identification and development of technology for evaluating and extracting marine minerals; principal leader for the air/sea interaction program, the marine environmental observation and prediction program; lead responsibility for coastal zone management; tsunami and hurricane warning; foremost responsibility for marine charting and mapping of Great Lakes, coastal and deep-ocean waters including geodesy and data storage; Sea Grant colleges and programs; National Oceanographic Data Center; National Oceanographic Instrumentation Center; National Climatic Center; development of data buoys; research on ship design, shipbuilding and ship operations; marine transportation and port systems.
Department of Health, Education and Welfare..... (Public Health Service, Office of Education, Food and Drug Administration)	Human welfare, healthfulness of food, biomedical research and support of education.
Department of Transportation..... (Coast Guard, Office of the Secretary)	Safety and protection of life and property in port and at sea; delineation and prediction of ice masses; navigational aids; oceanographic and meteorological observations; transport systems, analysis and planning; marine environmental protection.

Atomic Energy Commission.....	Radioactivity in the marine environment; development of marine nuclear technology.
National Aeronautics and Space Administration.....	Feasibility, design and engineering of spacecraft and sensors for ocean observations.
National Science Foundation.....	Basic and academic oceanography; principal leader for Arctic research and for facilities support of the International Decade of Ocean Exploration (Marine Science Affairs, 1971, pp. 2-3).
Smithsonian Institution.....	Identification, acquisition, classification and ecology of marine organisms; investigations of geophysical factors of the oceanic environment.
Environmental Protection Agency.....	Measurement and enforcement of water quality standards.

At present the burden of Texas marine-related resource development and management does not fall on any single state agency or department. On the contrary, almost all state agencies and departments are engaged in some marine-related activity. The development of a coastal resources plan has been undertaken by the Interagency Natural Resources Council. The council is composed of representatives from the following state agencies: General Land Office, Texas Air Control Board, Texas Highway Department, Texas Industrial Commission, Texas Parks and Wildlife Department, Texas Railroad Commission, Texas Soil and Water Conservation Board, Texas Water Rights Commission. Texas A&M University and the University of Texas at Austin are non-voting council members.

Education

The majority of research and development occupations require at least a bachelor's degree. Most research supervision, however, is conducted by scientists and engineers with advanced professional degrees or certification.

Employment Outlook

Opportunities in marine employment are particularly good for the individual who is well trained in a discipline, then specializes in the marine area pertinent to his expertise and interest. However, training first for the marine specialization does not appear fruitful; surplus of marine biologists, for example, already exists.

Many marine-related industries are seeking qualified personnel to enter their respective specialized fields. Great expectations are held for new careers in mariculture, offshore exploration and development, marine transportation and coastal and ocean engineering. The need for marine lawyers to resolve problems of the open ocean and of the coastal zone looks promising. The need for better environmental protection offers careers in various aspects of pollution control and abatement. On the other hand, it is unlikely that career opportunities will be so opportune that a person should specifically orient his goals according to this contention. The fluctuating needs of government and industry indicate no such need. An increasing demand, however, should be expected for individuals who have training in a basic discipline, then develop a commitment to marine affairs and resources.

Occupations for Research and Development

Professional

ACOUSTICAL (ELECTRONIC) LOGGING ENGINEER (See D.O.T.--010.288): This engineer measures sonar, electrical or radioactive characteristics of earth formations in order to locate oil- or gas-bearing reservoirs. He directs the hoisting engineer to lower instruments into the well and reads control panel meters to verify operating conditions of the equipment. In addition, he interprets graphs for customers to indicate the identity, porosity, oil- or gas-bearing content and productivity of geological formations. He also measures borehole diameters, direction of the borehole and inclination of the geological strata.

ADMIRALTY LAWYER(See D.O.T.--110.118): The admiralty lawyer specializes in legal matters relating to inland navigable waters or the high seas. He conducts lawsuits involving seamen, ship collisions, matters of cargo and damage inflicted by vessels. He draws legal documents including charter parties, registry applications for vessels under flags of a particular country and bills of sale for vessels. To determine applicable laws he studies the Constitution, statutes, previous decisions and regulations. The admiralty lawyer also advises clients concerning the prosecution and defense of a lawsuit or concerning legal rights and obligations in other matters.

APPLIED STATISTICIAN (See D.O.T.--020.188): The applied statistician surveys, collects, organizes, interprets, summarizes and analyzes numerical data on samplings or on complete enumeration bases; by applying statistical theory and methods, he is able to provide usable information in various disciplines. He evaluates reliability of data sources, adjusts and weighs raw data when necessary, organizes and summarizes data in tabular forms that are amenable to variance analyses and to principles of statistical inference. The statistician presents data in the form of tables and graphs; he writes reports describing data sources and limitations of data reliability or usability. Primarily concerned with use rather than with design of statistical tools, he analyzes and interprets data to emphasize significant differences and relationships among data sources by preparing conclusions and forecasts based on data summaries.

BIOLOGICAL OCEANOGRAPHER (See D.O.T.--024.081): He studies the oceanic animal and plant life and the environmental conditions affecting them. The biological oceanographer also studies the effects of ocean marine organisms on man-made materials, searches for ways to extract drugs from marine plants and animals, determines the effect of pollutants on the marine ecosystem and investigates the relationships between marine life and the surrounding physical parameters.

BIOLOGICAL STATISTICIAN (See Statistician, Applied in D.O.T.--020.188): The biological statistician plans, then conducts surveys and experiments to obtain data for basic scientific research related to life processes of humans, animals and plants. Using statistical methods, he studies relationships--resemblances and differences--between groups or organisms.

CHEMICAL OCEANOGRAPHER (See D.O.T.--024.081): This individual investigates the chemical composition of ocean water and sediments, as well as studies the elements that comprise seawater. He conducts research to determine the relationships between inorganic and organic compounds, the sources of dissolved and organic matter, the roles of major and minor nutrients in seawater and the extraction potentials of rare, valuable seawater components. He applies his oceanic knowledge to desalination problems to marine pharmacology and to extraction of modules and rare elements.

COASTAL AND OCEAN ENGINEER (See D.O.T.--): His work includes studies of beach development and erosion, of stability of offshore structures and of marine corrosion. He measures the effects of tides, currents and weather to determine the lifespan of coastal and ocean structures such as dikes, piers, drilling rigs and loading terminals. In order to project beach processes and harbor and waterway maintenance, this engineer reviews the effects of physical forces. He also studies navigable waters to determine the need for dredging and disposition of soil.

FISHERY BACTERIOLOGIST (See D.O.T.--041.081): In the laboratory this bacteriologist searches for methods of controlling bacteria and other microorganisms harmful to fish. Using microscopes, centrifuges and other equipment, he analyzes water samples from streams, lakes and other watercourses to detect harmful microorganisms. In addition, he studies the biology, ecology, physiology, morphology and pathogenicity of microorganisms identified with fish diseases. He ascertains the effectiveness of chemicals and bacteria that are destructive to harmful microorganisms but are not toxic to fish.

FISHERY SCIENTIST (See D.O.T.--): He surveys available shellfish and finfish resources, monitors populations of various species to determine fishing limits and studies the biological, chemical and physical factors that alter fishery resources. After assessing the fishery, this scientist often suggests legal constraints in order to protect the fishery against overexploitation.

GEOLOGICAL OCEANOGRAPHER (See D.O.T.--024.081): The geological oceanographer studies composition, structure and history of the earth's crust. He examines rocks, minerals and fossils to identify and to determine the sequence of processes affecting the earth's development. This oceanographer applies

knowledge of chemistry, physics, biology and mathematics to explain these phenomena as well as to locate minerals, petroleum deposits and underground water resources. He studies topographic features, rocks and sediments of the ocean bottom; applies his geological knowledge to engineering problems (such as dams, tunnels and large buildings) encountered in construction projects; considers fossil plants and animals to determine their evolutionary sequence and age; prepares geological reports and maps; interprets research data; and recommends further study or action.

GEOGRAPHER (See D.O.T.--029.088): The geographer studies the nature and use of the earth's surface areas by relating and interpreting interactions of physical and cultural phenomena. He researches physical and climatic aspects of areas or regions, making direct observations and incorporating available knowledge from related scientific fields such as physics, geology, oceanography, meteorology and biology. The geographer studies human activities within given areas such as ethnic distribution, economic activity and political organization. He may advise or consult with governments and international organizations on such subjects as economic exploitation, determination of ethnic and natural boundaries between nations or administrative areas. The geographer may use surveying equipment or meteorological instruments; he may also construct and interpret maps, graphs and diagrams.

MARICULTURE SPECIALIST (See D.O.T.--): He works to cultivate and to propogate marine plants and animals under laboratory or field conditions. The mariculture specialist develops enclosed or semi-enclosed growth systems where he can grow commercially important marine animals for marketing; he may work with algae, shellfish or finfish. The mariculturist develops intensive culture methods to provide sizable crops in small systems. His efforts are directed at providing a food source beyond those available from fishing.

MARINE (AQUATIC) BIOLOGIST (See D.O.T.--041.081): This biologist studies aquatic plant and animals and environmental conditions that affect them. He investigates water temperature, acidity, light, oxygen content and other physical conditions to determine their relationship to aquatic life. In addition, he examines various types of water life such as plankton, worms, clams, mussels and snails. He may work in the marine or freshwater environment.

MARINE (INDUSTRIAL) ECONOMIST (See D.O.T.--050.088): To ensure the maximum use of assets and to develop desirable markets, this person studies and analyzes the economic factors involved in marine production, distribution and use of goods or services. He examines production costs and techniques, methods of financing and marketing policies to discover possible improvements. The economist studies the organizational structure of business concerns and the relationship to marketing products such as fresh seafood. He also interprets the effects of governmental regulations and restrictions.

MARKET-RESEARCH ANALYST (See D.O.T.--050.088): This analyst researches market conditions in local, regional or national areas to determine potential sales of products such as fresh seafood. He analyzes statistical data on past sales and examines wholesale or retail trade trends to forecast future sales. He gathers data on competitors, then analyzes their prices, sales and operation methods. The analyst also collects data on buying habits and preferences

of prospective customers. He determines the supply of various marine commodities needed to correspond to expected demand.

METEOROLOGIST (See D.O.T.--025.088): This person studies atmospheric conditions and related meteorological data in order to forecast immediate and long-range weather changes. To make forecasts he analyzes and interprets synoptic charts, maps, prognostic charts and meteorological data such as barometric pressure, temperature, humidity, wind velocity and areas of precipitation. He investigates meteorological aspects of aurora and air glow, radio propagation and cosmic rays. The meteorologist conducts research on long-range forecasting, severe weather phenomena, solar heating and other problems. He draws isobars on surface maps that indicate fronts, precipitation areas, high and low barometric pressure, falling and rising pressure. He also predicts movements of fronts, precipitation and pressure areas. As an adviser, he confers with airplane pilots, commercial and other flight personnel regarding meteorological data such as winds aloft, ceilings, visibility, icing conditions, thunderstorms, other forms of turbulence and movements of cloud formations.

OCEANOGRAPHIC ENGINEER (See D.O.T.--024.081): He designs and builds the equipment and instruments used in oceanographic research. The oceanographic engineer may be involved in supervising underwater construction and repair, laying pipelines and cable and recovering sunken or lost vessels with their cargoes.

PHYSICAL OCEANOGRAPHER (See D.O.T.--024.081): The physical oceanographer studies physical aspects of the ocean such as salinity, temperature and density. He studies seawater and its ability to transmit light and sound; in order to better understand weather phenomena, he observes relationships between the sea and atmosphere. He studies the cause-effect characteristics of tides and currents as well as the unique weather conditions created by extreme changes.

TECHNICAL WRITER (See D.O.T.--139.288): In clear and concise language he writes manuals and related technical publications concerned with science or engineering. He acquires or verifies technical knowledge of a subject by interviews with workers engaged in developing new equipment or in making improvements. The technical writer observes, then records experimental performance and production methods; he refers to engineering drawings and notes, trade and engineering journals, experiments and methods of production. Making rough sketches to aid artists in their final drawings, he oversees preparation of illustrative materials and selects photographs, drawings, sketches, diagrams and charts. He may also assist in preparation and layout of publications. In addition, the technical writer may edit scientific or engineering reports, manuals and publications.

Technical

DIVER (See D.O.T.--889.281): Working below the surface of the water, he employs scuba gear or a diving suit with an airline extension to the surface in order to inspect, repair, remove and install equipment and structures. Aided by a diver helper, the diver descends into the water and communicates

with the surface by signal line or telephone. He inspects docks, ship bottoms and propellors; repairs vessels below waterline, replacing missing or leaking rivets with bolts; and caulks leaks in ships or caissons. The diver also cuts and welds steel with an oxyacetylene cutting torch and arc welding equipment, cleans debris from intake and discharge strainers and removes obstructions from marine railway or launching ways with pneumatic and handtools. In addition, he levels rails by driving wedges beneath the track with a maul or sledge hammer, removes launching cradles and sliding ways from keels of newly launched vessels, places the rigging around sunken objects and hooks the rigging to crane lines and rigs explosives for underwater demolitions. The diver may search for lost, missing or sunken objects such as bodies, torpedoes, sunken vessels and equipment; may place recording instruments below the water's surface prior to underwater tests or experiments; may set sheet pilings for cofferdams and may drill holes in rocks at the bottom of the harbor for blasting purposes. He also may use armored diving equipment for dangerous missions.

DIVER HELPER (See D.O.T.--899.884): This person helps the diver into his diving suit, inspects diving equipment and maintains communications with the submerged diver by lifeline or telephone. For hard-hat diving, he helps the diver into a suit equipped with a hardshell headpiece, breathing hose, belt, breast weights and leaded feet. The aide examines equipment for possible obstructions in the airhose and in the communication line and checks to see that air pressure agrees with the diver's specifications. He hands equipment to the diver and helps him into the water, attends the lifeline and telephone to receive signals from the diver (such as tugs on the lifeline and instructions on the telephone) to pull in or let out the lifeline and airhose. The diver helper, if only assigned to let out and take in the airhose, may be designated a hose tender.

DIVER PUMPER (See D.O.T.--899.782): He operates a portable hand pump or motor-driven air compressor in order to provide the diver with fresh air. This person places the air pump or air compressor near the place where the diver enters the water. The diver pumper turns the hand crank or starts the compressor motor to pump air, observes the pressure gauge to ensure that required pressure is maintained. He also oils the cylinders and bearings of the pump and replaces air filters.

MARINE TECHNICIAN (See D.O.T.--): This technician aids scientists and engineers in gathering and disseminating sea-related data. He performs tests, operates scientific equipment and records results of experiments that he conducts according to a scientist's direction. The marine technician must have a basic knowledge of oceanography, fundamental chemical and physical concepts, testing and experimental procedures. If the technician works aboard a research vessel, he must be familiar with basic seamanship and shipboard engineering. He partially acquires his knowledge by attending technical schools or universities; he may or may not have a degree.

MICROBIOLOGY TECHNOLOGIST (See D.O.T.--078.281): He cultivates, isolates and assists in identifying bacteria and other microorganisms, in addition to performing various bacteriological, mycological, virological and parasitological tests. The technologist receives samples or collects specimens under a microbiologist's supervision. He examines materials for disease or parasites, using laboratory equipment such as microscopes, incubators and centrifuges.

TECHNICIAN (See D.O.T.--637.684): This term refers to a person whose work directly supports engineers or scientists; the technician utilizes theoretical knowledge of fundamental scientific, engineering, mathematical or draft design principles. He solves practical problems encountered in specialization fields such as developing electrical and electronic circuits, and in establishing methods for testing electrical, electronic, electromechanical and hydromechanical devices and mechanisms. The technician applies engineering principles in solving design, development and modification problems for products or systems; he is also involved in applying natural and physical science principles to basic or applied research problems in fields such as metallurgy, chemistry and physics. The technician may work with engineers and be designated an engineering aide. He may utilize his training while participating in sea research or exploration.

SHIPBUILDING AND REPAIR

Introduction

Because of the variety of exports, imports and fishing activities, Texas seaports have developed a diversified system of shipbuilding and repair facilities with the primary center of activity in the Houston-Galveston area.

Shipbuilding and repair activities along the Texas Gulf Coast include construction of tugs, towboats, barges, tankers, cargo ships, oceanographic vessels, mobil oil drilling rigs, shrimp trawlers and various pleasure crafts (Boykin, 1971, p. 8). Companies include Todd Shipyards, Levingston, Rockport Yacht and Supply Company, Bludworth Shipyards, Gulfport Shipbuilding Company, Marine Mart and Marathon Le Tourneau Company (Miloy and Copp, 1970, p. 75).

Occupations related to shipbuilding, ship repair and drilling rig construction are similar because marine construction, marine repair and drill rig construction industries employ personnel from common trade areas. Such skilled and semiskilled workers as welders, caulkers, painters, riveters and chippers are employed by most marine construction and repair firms.

A number of support occupations are included in a shipyard. An example is the chemist, whose main responsibility is to ensure that all yard areas are safe. No hot work is allowed on ships or any vessels until the chemist issues a Gas Free Certificate. On tankers a constant check is required because a ship with a non-force ventilated tank can be freed of gas, checked and certified "Gas Free," then become gaseous again after a few days.

Education

Many skilled or semiskilled occupations in the shipbuilding-repair industry are learned through an apprenticeship-type training program. Some employees, hired at shipyards as laborers, advance upward as they gain experience or participate in training.

Several boilermaker-related occupations can be learned through plant-operated training programs. Todd Shipyards of Galveston and Marathon Le Tourneau of Brownsville conduct such in-plant programs for welders. Full-time employees may enroll in these programs during their spare time; upon completion of the program, participants may become certified marine welders by passing an examination conducted by the American Bureau of Shipping.

The volume of shipbuilding and ship repair work is proportional to the volume of merchant marine activity conducted by United States Flag Merchant Marine companies. Since the United States merchant marine fleet has been in a state of decline during the past two decades, shipbuilding and repair work has also decreased.

During 1967-1971 the total value of shipbuilding and repair work in the United States remained constant at approximately $2600 million per year. Employment figures, on the other hand, decreased from 138,000 in 1967 to 126,800 in 1971 (U.S. Industrial Outlook, 1972, p. 319).

Employment Outlooks

Employment outlooks for the future are optimistic. The Merchant Marine Act of 1970 authorizes shipyards and shipowners to receive government subsidy assistance for constructing merchant ships.

Shipbuilding and repair industries located along the Texas Coastal Zone employed 6,451 workers in 1969 with sales totaling approximately $126 million (Miloy, p. 75). The average hourly wage for the shipbuilding industry was $4.11 in 1971, compared to $5.08 per hour for the heavy construction industry (U.S. Industrial Outlook, 1972, p. 320).

Occupations for Shipbuilding and Repair

BOILERMAKER (See D.O.T.--804.281): The boilermaker fabricates and assembles new boilers, tanks and pressure vessels; he also repairs defective tank-type equipment. Following blueprints and using tools such as squares, hammers, transit, straightedges, plum bobs, levels and blocks, the boilermaker prepares ship-for-shore foundations, constructs boiler sections from plate and structural materials using grinders, cutting, welding and riveting equipment. He assembles the boiler or pressure vessel components and rigs the completed structure for placement. When the boiler is finished, the boilermaker installs valves, guages, hand holds, manholes, etc., using pipe wrenches and cutting equipment. The boilermaker also is involved in caulking and sealing the completed structure to prevent leakage. If the shipyard is unionized, valves are installed by machinists or pipefitters, depending on the size and type of connection (flanged or screwed); gauges are installed by machinists.

RIVETER (See D.O.T.--800.782): The riveter, using a pneumatic hammer and aided by a bucker, joins the structural component and plates used in fabricating a ship's hull and superstructure. The riveter selects a rivet compatible with predrilled holes in the plate and, while the bucker holds the rivet in place, spreads the rivet shank by engaging the rivet hammer.

CHIPPER (See D.O.T.--800.): A chipper uses a pneumatic tool, equipped with various shaped points, to bevel plates; he also removes burrs and rust from the hull and deck of a ship. This occupation requires a limited degree

of skill, but the operator should be familiar with the use of hydraulic equipment. General rust and scale is removed by a laborer at a lower pay scale.

CAULKER (See D.O.T.--843.): The caulker, using hand or pneumatic caulking equipment, seals pipes and tunnel linings by forcing the caulking compound into the pipe and tunnel lining points. When these joints are sealed, the pipes and linings become airtight and/or watertight.

BOILERMAKER-RIGGER (See D.O.T.--): A boilermaker-rigger rigs booms, plates, lifeboats, lift slings and other cables on a ship. He should be familiar with the operation of winches and other mechanical lifting equipment and should be able to splice cable. Former merchant marine mates are often hired for this position because of their rigging experience at sea.

DRILLER (See D.O.T.--809.884): Following marks on structural shapes and plates, the driller uses a hammer and punch to make small indentions. He then drills rivet and bolt holes in the structural shapes and plates, using a portable power drill. These skills are also performed by the boilermaker and machinist when necessary.

REAMER (See D.O.T.--): A reamer and a driller perform many of the same tasks. He enlarges holes to an accurate tolerance, then countersinks or counterbores. (Many holes that were once drilled and reamed are now punched on a punch press.) These skills are also executed by the boilermaker and machinist when necessary.

BURNER (See D.O.T.--): A burner uses an acetylene cutting torch to cut and to shape metal. He should possess skills similar to those of a welder, i.e., the ability to read blueprints and layouts and to regulate gauges. The burner should have a working knowledge of metallic characteristics. (Many burning operations once done by hand are now performed by machine. Numerically controlled burning equipment is gaining wide acceptance in many shipbuilding and ship repair operations.)

SHIPFITTER (See D.O.T.--806.381): The shipfitter, following blueprints and using templates and handtools such as the scribe, lays out structural components for ship hulls and superstructures. Using bending brakes, roll presses, cutting and welding equipment, he fabricates the components. In addition, the shipfitter installs and aligns the completed members using jacks, wedges, turnbuckles, etc. He is also responsible for installing secondary accessories such as doors and hatches as well as for manufacturing odd or irregular shapes.

COLD PRESSMAN (See D.O.T.--617.280): The cold pressman is charged with setting up and operating heavy hydraulic presses used to form or to straighten structural shapes and plates. Working from blueprints, he selects the dies needed for an operation, then installs these dies in the press. The pressman, using his vision, tapes, straightedges, etc., aligns working materials in the press according to blueprint specifications or to

lay-out marks; he engages the machine to drop the ram, thereby performing the operation. Following completion of the operation, the cold pressman checks to see that the piece conforms to specifications.

LAYER-OUT (See D.O.T.--809.291, 809.781): The layer-out works from blueprints and uses handtools such as punches, scribes and soapstone. He marks reference lines, hole positions, bending fold lines, curves, etc., on structural shapes and plates so that welders, drillers, cold pressmen and bolters-up can fabricate and assemble components used in ship hulls and superstructures.

ROLL OPERATOR (See D.O.T.--709.): A roll operator uses a hydraulically operated roll-former to bend metal into cylindrical and curved shapes. He must be able to work from blueprints and adjust the spacing between slip rolls. The roll operator may also be employed as a shear or press operator, a grinder and a driller-reamer.

STRAIGHTENER (See D.O.T.--709.884, 617.782): The straightener uses handtools and mechanical devices such as the furnace or heating and cutting equipment to remove dings and dents from ship hulls and superstructures by straightening or "fairing" the affected section. After heating the metal to the proper temperature, the straightener applies force with a hammer to align the indention with the remainder of the structure. Using straightedges or templates assures proper alignment. If the straightening process occurs off the ship, the straightener may use an anvil or straightening press to remove the irregularity from the workpiece. (At one time "fairing" was a common procedure; but since the process is so costly and time-consuming, many shipyards prefer to remove and to replace the damaged section rather than to straighten it.)

TANK TESTER (See D.O.T.--): A tank tester checks vessels, boilers, pressure tanks and compartments for leaks by air or hydrostatic pressurizing. He should be familiar with the principles of air pressure and pneumatics. Usually a tank tester is hired not for this occupation specifically but as a welder, shipfitter, burner and outside machinist; he performs as a tank tester when required.

GRINDER (See D.O.T.--705.884): By sight and touch, the grinder detects indentations or imperfections such as rust, welding slag and splatter, burrs, etc., on the work surface. After selecting the proper abrasive and affixing it to his portable grinder, he grinds and smooths the surface. A boilermaker sometimes performs this skill if necessary.

PUNCH-PRESS OPERATOR (See D.O.T.--615.782): The punch-press operator is responsible for setting up and operating hydraulic punch-presses that punch and notch structural shapes and plates. Working from blueprints, he selects the dies needed for an operation. Using wrenches, feeler gauges, etc., he then installs and aligns the dies in the press. Working from blueprints and from lay-out marks, this operator uses straightedges, tapes, etc., to align the workpieces in the punch-press. He then engages the machine

to drop the ram and to complete the operation. After the operation is completed, the punch-press operator checks the piece to see that it conforms to specifications.

SHEAR OPERATOR (See D.O.T.--615.782, 615.885): The shear operator is responsible for setting up and operating large hydraulic shears used to blank and cut structural shapes and plates. Working from blueprints and using handtools such as hammers, wrenches and tapes, the shear operator sets up stops. Aided by a helper or hoist, he positions the working material on the shear table and aligns the stock. When the material is properly positioned, the operator engages the shear, the blade of which has been adjusted for proper rake angle and pressure, and blanks or cuts the piece. After completing the operation, the shear operator checks to see that the piece conforms to specifications.

TEMPLATEMAN (See D.O.T.--): A templateman forms wood or metal templates to the shape of the ship being repaired, reworked or replaced. He is highly skilled and gains his position after many years of experience as a shipfitter, coppersmith or lay-out man.

WELDER (See D.O.T.--810.884): A marine welder, a skilled worker, is often certified by the American Bureau of Shipping and/or the U.S. Coast Guard to perform welding aboard ship or in the yard. The welder, working with electric welding equipment, fuses metal parts together to fabricate, to repair or to enlarge objects or equipment. Prior to the actual welding, he sees that the welding machine is properly grounded, starts the unit and regulates its rheostat to obtain a voltage and current compatible with the selected wire size. During the welding operation an arc is struck by the welding electrodes, and molten metal flows from the separate metal pieces being welded into a bead. The welder then chips the weld to remove excess slag and inspects it for defects.

LOFTSMAN (See D.O.T.--661.381, 661.131): Utilizing engineering drawings and offset tables, the loftsman lays out full-size contours of a ship's hull on the loft floor. Templates and molds are constructed from the contours and are used in fabricating and positioning structural components aboard ship. In addition to drafting lay-outs, the loftsman prepares new tables of offsets and compares these with tables provided in the blueprints.

SHIP CARPENTER (See D.O.T.--860.381): Employing pencil, chalk, tapes, straightedges, blueprints, etc., the carpenter lays out woods of fibrous materials used in fabricating structures, cabinets and appointments aboard ship. He also installs lignum vitae in the stern tube. The carpenter uses hand and power tools such as hammers, saws, planes, cuts, shapes and assembles to finish the materials; the completed structure is then checked for trueness with the level and plumbob. In addition, the carpenter may install prefabricated materials such as doors, windows and doorframes, interior trim; he may finish hardware and erect scaffolding to be used by craftsmen and by laborers working above deck or ground level.

MILL AND MAINTENANCE CARPENTER (See D.O.T.--860.281): The mill and maintenance carpenter differs from the ship carpenter in that he primarily does indoor work on cabins, quarters and rooms with cabinets, counter tops, benches, floors, partitions, trim, etc. Using hand and power carpenter tools, he may work from drawings or from verbal instructions. Though many interior appointments may be constructed at the job site, much cabinet work is prefabricated so that the mill and maintenance carpenter's task is installation.

WOOD CAULKER (See D.O.T.--843.884): The wood caulker's activities primarily involve the construction and repair of wooden vessels. His job is to seal the ship's hull and deck planking to ensure that it is water-tight. Using a caulking iron, cotton line, hemp, pitch, putty and mallet, he caulks the plank seam by forcing prepared caulking compound into the crevass or by tamping cotton line and hemp into the crack. He further seals the break by applying hot pitch or putty. (Because the majority of activity performed in modern shipyards deals with constructing and repairing steel ships, the wood caulker is gradually becoming obsolete.)

CLEANER (See D.O.T.--891.887): With water or chemical solvents and handtools such as brooms, scrapers, shovels, etc., this employee cleans the interior of boilers and tanks aboard ship or in the shipyard. He scrapes and chips deposits from walls, scrubs the walls with water or solvents and flushes the tanks or boilers.

HULL SCRAPER-SCALER (See D.O.T.--): A scaler removes paint from the ship's hull with a pneumatic tool equipped with a flat point. A hull scraper removes barnacles and seagrowth from the hull with a hoe or long-handled scraper. (Scraping and chipping operations may be completed before the ship's hull is shotblasted.)

DRYDOCK HAND (See D.O.T.--891.884): With the aid of a forklift, a drydock hand positions large wooden blocks on the deck of a floating drydock to make ready a support system for the ship's hull. He also secures the ship to the drydock with ropes and helps to maneuver the ship into its proper position over the submerged blocks. The drydock hand is semiskilled and rises to the position of pumpman and line-up man after gaining sufficient experience.

DRYDOCK HEAD LINEMAN (See D.O.T.--891.884): A drydock head lineman directs placing of wooden supports on the drydock, the lowering and raising of the drydock amd the accurate positioning of the ship over the drydock before it is raised to an above-water position. The head lineman stands on ship and signals by hand drydock workers who are maneuvering the ship. A drydock head lineman usually attains his position after working several years as a drydock line-up man.

DRYDOCK HEAD LINE-UP MAN (See D.O.T.--891.884): A drydock line-up man employs ropes attached to the ship, tugs and winches to maneuver the ship into its proper position over the submerged drydock. (When the ship is properly positioned, water in the drydock pontoons is pumped out and the ship is elevated to an above-water position.) He also supervises other drydock hands during docking and undocking operations.

DRYDOCK PUMPMAN (See D.O.T.--891.884): This person pumps water into and out of pontoons attached to the bottom of a floating drydock. In order to keep the dock "trim" (level), he must man the pumps constantly during his work shift. Also responsible for pump inspection, the pumpman reports any malfunction in the drydock pumping system. He also supervises the maintenance and repair of the drydock.

DRYDOCK MAINTENANCE ENGINEER (See D.O.T.--891.183): A drydock maintenance engineer supervises the repair of drydock pumping equipment and auxiliary systems when the drydock is not in use or in time of emergency. Although the drydock maintenance engineer sometimes has formal training in mechanical engineering and hydraulic systems, he reaches his position by working under another drydock maintenance engineer for a number of years.

ELECTRICIAN (See D.O.T.--825.138, 825.281): Working from blueprints and wiring diagrams, the electrician uses hand and power tools to fabricate instrument panels and to repair and to install all electrical and electronic wiring aboard ship and in the shipyard. In addition, he installs various electrical devices such as voltage regulators and switch panels. The electrician checks the electrical characteristics of the circuitry using ohmeters, voltmeters, etc.

HELPER (See D.O.T.--): The helper aids another worker whose level of competence is generally above that of the helper. The helper gathers tools and materials and performs routine duties.

SHOTBLASTER (See D.O.T.--503.887): By directing a compressed air-propelled stream of sand or shot, a shotblaster cleans scale, paint, rust and minor surface imperfections from the ship's hull and superstructure. This proecess not only cleans but also produces an even finish to which protective coatings may be easily applied. Wearing gloves and helmet to protect against reflection of shot from the work surface, the shotblaster directs the abrasive-laden blast and adjusts the compressor equipment to ensure uniform flow.

ROUGH PAINTER (See D.O.T.--741.884, 741.887): The rough painter applies protective coatings such as paint or varnish to surfaces that do not require a fine finish. He cleans the surface with wire brushes or sandpaper, mixes the coating and applies the finish with a roller, brush or spray gun.

MACHINIST (INSIDE) (See D.O.T.--600.280): The machinist works from engineering drawings, sketches, prototypes or part descriptions and uses such machine tools as lathes, shapers and milling machines. He manufactures, repairs and assembles tools, mechanisms and machines that are used aboard ship or on shore. The machinist selects, marks and lays out the stock; he determines various machine operations and their sequence in order to translate raw materials into a finished product. The machinist checks the manufactured part against specifications to determine whether the dimensions fall within acceptable tolerances. In addition to using machine tools, he employs fastening devices such as vices and V-blocks to affix the workpiece to the worktable; he utilizes micrometers, gauge blocks and height gauges to measure accurately the final product.

LABORER (See D.O.T.--): The laborer performs entry level duties that require no skill but must be performed in order for a company to function efficiently. He cleans, sorts and gathers tools, equipment and supplies. The laborer generally enters a particular field in which he has no salable skills; because of this, he is relegated to performing these simple, basic tasks.

MACHINIST (OUTSIDE) (See D.O.T.--600.): The outside machinist installs and repairs machinery aboard ship such as propelling and steering equipment, refrigeration and cargo-handling machinery. He makes and replaces necessary seam joints and reassembles engines or pumps to ensure proper operation. The machinist grinds or refaces valves and valve decks on cargo, bilge, water and boiler feed pumps; he replaces necessary rubber gaskets on covers. He also repairs and replaces boiler condenser tubes, positions and aligns new machinery, drills and reams holes and installs holdown bolts. The machinist removes and replaces rotors, bearings and thrust bearings in turbines; he also removes and replaces rudders, propellors and propellor drive shafts. He replaces all hydraulic steering apparatus, repairs and replaces small gasoline engines used in life boats, ferry boats, trucks and other equipment. The machinist must be familiar with the safe operation of all portable power equipment used in the machine shop and with the metal-working trades. In addition, the outside machinist should know the principles of hydraulics, pneumatics, electrical circuitry and steam pressure. He should be able to read blueprints, to use precision measuring equipment and to do simple mathematical calculations. The outside machinist usually works as an apprentice for a number of years before attaining his position. Many machinists gain experience in the ship's engine room by serving in the U.S. Navy or in the Merchant Marines.

TOOL AND DIE MAKER (See D.O.T.--601.280, 601.281): Following specifications and blueprints, a tool and die maker lays out, machines, assembles and disassembles cutting tools, gauges, handtools and dies. The tool and die maker should have in-depth knowledge of precision measuring equipment and a familiarity with laying-out metal. He occasionally tests and inspects the operation of various mechanisms.

AIR COMPRESSOR AND BOILER OPERATOR (See D.O.T.--950.885, 950.782): This operator maintains the equipment that supplies compressed air for the operation of pneumatic equipment such as chipping, sandblasting and grinding machinery. He regulates pressure gauges, cleans equipment and hooks up pipelines for convenient access by operators. An air compressor operator may also act as a boiler operator, who controls and operates low-pressure steam boilers. In this capacity, he performs many of the same tasks of the air compressor operator, i.e., adjusting valves and pressure, reading gauges and repairing equipment.

DERRICK BARGE OPERATOR (See D.O.T.--921.883): The derrick barge operator maneuvers a boom mounted on a boat or barge to lift and to transfer heavy objects from one location to another. This operator positions the barge, operates control levers of the hoist, oils machinery and checks to see that the hoist works properly.

GANTRY CRANE OPERATOR (See D.O.T.--921.883): This employee operates electric- or diesel-powered derrick cranes to lift and to manipulate heavy objects. Like the derrick crane operator, the gantry crane operator positions the crane, manipulates controls, oils the machine and inspects the crane to see if it functions correctly. (The derrick crane differs from the gantry crane in that it moves along ground tracks when transferring loads from one end of the ship to the other.)

CRANE ASSISTANT (See D.O.T.--892.883): This employee assists the crane operator in attaching ropes, cables or chains to the object being lifted. He signals the crane operator when moving loads in and out of confined spaces. The crane assistant may also assist the crane operator in inspecting and in maintaining the lifting equipment. He also operates forklifts, go-devils and cherry-pickers.

LOCOMOTIVE ENGINEER (See D.O.T.--910.383): The locomotive engineer operates steam electric, diesel electric or gas-turbine electric locomotives to move equipment, materials and men from one worksite to another in the yard. Prior to starting each run, he inspects the engine to see that it operates properly; he also checks to see that the engine is adequately fueled, sanded and watered. The engineer observes proper railroad rules and regulations to ensure safe operation of the train. When the run is completed the engineer reinspects the equipment to determine if breakage or defects have occurred.

PAINTER (See D.O.T.--840.781): This person does all painting in the plant, on ships, on mechanical equipment, on wharves or on drydocks. He paints the ship's hull above the deepload line. He also paints the ship's superstructure, hull interior, engine rooms and all compartments. The painter may use spray guns or roll brushes in performing his duties. Certain painters are primarily sign painters; others are assigned to small spray paint shops where they paint smaller objects such as safety hats or small pieces of furniture and check and repair spray paint equipment. The painter mixes and blends colors; he also works from scaffolding, bosun's chairs or barges, usually with no helpers. A first-class painter acquires his position after about four years' work as an apprentice painter.

PIPE FITTER (See D.O.T.--862.281): Following a set of specifications and blueprints, the pipe fitter repairs and installs hydraulic, air and oil lines in a ship. He must be familiar with various pipe fittings, be able to use pipe cutting and threading equipment, be able to solder and to seal joints, be able to connect pipes with wrenches and to check for leaks. The experienced pipe fitter should have a knowledge of hydraulic, electrical, steam and compressed air principles and simple shop mathematics.

PIPE COVERER OR INSULATOR (See D.O.T.--863.381): A pipe coverer, also called a lagger, prepares and installs asbestos, magnesia and other insulating material on pipes, tanks, valves, boilers and other equipment requiring thermal insulation. The pipe coverer may remove old insulation from equipment before it is reinsulated. He may also cover drain and sewer pipes with felt or tar paper and with a canvas outer covering to prevent

sweating. He usually attains this position after working for a short time period as an apprentice. Many times a pipe coverer performs the duties of a pipe fitter when not engaged in his speciality and may be listed on the payroll as a pipe fitter.

COPPERSMITH (See D.O.T.--862.281): A coppersmith performs specialized work, usually in the pipe shop. He fabricates or assembles sections of brass, copper, steel or lead pipe. The coppersmith usually works from a set of plans, specifications or verbal descriptions to make wooden templates and to determine bends in pipe sections. He bends and welds pipe with an acetylene torch, and he must also be able to lead-wipe copper lines. A coppersmith possesses considerable knowledge of metals, alloys, methods of joining metals, fluxes and proper welding and brazing techniques. Many shipyards hire a coppersmith under the title of pipe fitter. A coppersmith usually reaches his position after serving several years as an apprentice.

ACETYLENE-PLANT OPERATOR (See D.O.T.--549.885): An acetylene-plant operator maintains, regulates and repairs equipment that controls the chemical process used in producing acetylene gas (calcium carbide-water reactions). The operator adds calcium crystals to the hopper, runs the generator and regulates water temperature. He may also fill cylinders with gas and check filled containers for leakage.

RATPROOFER (See D.O.T.--): Using such materials as caulking compound, plastic or sheet metal, a ratproofer patches openings in a ship's bulkhead to prevent the movement of rodents from one compartment to another. He also secures sheet metal cones on tie-down ropes of a ship when it is in port; these cones prevent rats from boarding or leaving the ship. An employee is usually hired to perform not only as a ratproofer but also as a sheet metal worker, carpenter or caulker.

CEMENTMAN (See D.O.T.--): A cementman coats the inside of a ship's freshwater tanks with a mixture of portland cement and water. This coating assures purity of the freshwater drinking supply. A cementman may also form cement blocks used for floor pilings.

RIVET HEATER (See D.O.T.--504.885): He is responsible for supplying the riveter and his helper with enough rivets for the riveting operation. After heating in a coke, gas or oil furnace until they are red hot, rivets are transferred to the riveting location with a pair of tongs. A rivet heater determines when rivets reach the proper temperature, removes them from the furnace and passes them to his helper.

BUCKER (See D.O.T.--800.887): Riveters and buckers work in pairs. The riveter peens the shank end of the rivet while the bucker presses a metal bar or die against the rounded end of the rivet (head) to maintain the rivet's fixed position.

SHEET METAL WORKER (See D.O.T.--804.281): Working from plans or specifications, the sheet metal worker fabricates, installs and repairs such products as control boxes, ventilators, drainpipes, lifeboats and ductwork. The sheet metal worker operates a variety of fabrication machines,

molds metal parts with forming brakes and bench stakes, solders, welds, brazes joints and connections and inspects assemblies for accuracy. He usually acquires his position after working as an apprentice for a number of years.

SHOP CRANE OPERATOR (See D.O.T.--921.883): A shop crane operator operates a monorail crane to maneuver and to transfer materials from one location to another. Whoever calls for the lift also signals, hooks and unhooks. The crane operator checks cables, lubricates equipment and cleans the cab.

TRACK LABORER (See D.O.T.--): A track laborer lays and repairs track in plant yards. He must be able to operate power equipment used for removing old ties and positioning new ones as well as positioning and nailing tracks in place. The track laborer may also clean and lubricate switches and equipment, inspect track and remove fallen material from the track right of ways.

MARINE ENGINEER (See D.O.T.--014.081, 014:187): Essentially there are two types of marine engineers. One designs and supervises the installation and repair of mechanical and electrical equipment aboard ship and onshore at marine facilities. Due to his advanced educational training, he can prepare equipment specifications, conceive ideas for equipment and systems and perform complex and often time-consuming or tedious calculations necessary to equipment or system creation. Following construction of his ideas, the marine engineer also may participate in equipment evaluation during shakedown or acceptance trials. The second type of marine engineer maintains and repairs ship machinery. He determines the extent of damage to a particular machine and estimates type and cost of repairs necessary. The marine engineer determines specifications, lays down maintenance plans and calls for bids on maintenance work. Through his subordinates, the marine engineer inspects repaired equipment and materials and ensures that the contractor complies with predetermined specifications. The marine engineer also represents management by inspecting and accepting the completed job.

MARINE ARCHITECT (See D.O.T.--001.081): The marine architect designs marine vessels and floating structures. Working from design proposals and within predetermined specifications, he conceives and designs the configurations for the hull and superstructure. Using a model basin, the architect tests his ideas to determine whether or not the configuration will perform according to calculations and within the design requirements. After testing, he may modify the prototype to maximize performance; from the final design he develops sectional and waterline curves, buoyancy and stability data. He also plans the vessel's interior, aided by the marine engineer, in selecting and placing mechanical and electrical equipment.

DRAFTSMAN, HULL-BALLAST CALCULATION (See D.O.T.--019.188): Working from blueprints and with weights of a ship's components, this draftsman determines the vessel's unloaded weight and center of gravity. If ballast is necessary, he prescribes weight and location as calculated from various formuli. When dealing with submersible vehicles, he determines the vessel's weight and center of gravity in order to prescribe weight and positioning of ballast needed for proper buoyancy.

DRAFTSMAN, HULL-STRESS CALCULATION (See D.O.T.--017.281): This draftsman determines the stresses to which various structural members will be subjected. From this data he determines size, shape, material and weight of the members.

MARINE DRAFTSMAN (See D.O.T.--014.281): Several subheadings are listed under marine draftsman; all specialize in preparing structural, machine or electrical drawings for marine vessels or shore installations. These drawings are prepared from designs and notes supplied by the marine architect or marine engineer.

DRAFTSMAN, HULL (See D.O.T.--014.): Working from prescribed dimensions, the hull draftsman develops drawings of longitudinal and horizontal cross-sections, of rudder frame and support and of longitudinal and transverse bulkheads. He prepares deck plans in addition to rigging and boom details.

DRAFTSMAN, HYDRAULIC (See D.O.T.--014.): This draftsman is primarily concerned with onboard hydraulic equipment and systems. He determines specifications, designs hydraulic equipment and prepares engineering drawings of his designs.

DRAFTSMAN, SHEET METAL (See D.O.T.--014.): The sheet metal draftsman prepares engineering drawings of sheet metal components and equipment used aboard marine vessels.

DRAFTSMAN, SHIP ENGINEERING (See D.O.T.--014.): Working from his basic calculations and designs, the ship engineering draftsman prepares assembly and detail drawings of engines, auxiliary and support equipment aboard ship. With his knowledge of materials and calculations, he designs supports and foundations for this equipment.

BOATMAN (See D.O.T.--): The boatman operates small utility watercraft around the shipyard. These boats transport men, equipment and materials from shore to worksite and between shipyard and subplant.

APPENDIX

PERSONS INTERVIEWED REGARDING MARINE OCCUPATIONS

Name	Firm	Address
Mr. Roger Anderson	Center for Marine Resources Texas A&M University	305 Mobiltown Drive Bryan, Texas 822-2091
Mr. Walter Anderson	Port of Galveston	802 Rosenberg Street Galveston, Texas 765-9321
Mr. Mike Bonsignore	Moody College of Marine Sciences and Maritime Resources Galveston, Texas	Mitchell Campus Galveston, Texas 744-7161
Capt. John W. Cain	Atlantic & Gulf Stevedores Union	2411 The Strand Galveston, Texas 762-4200
Ms. Kathryn Delaune	Industrial Economics Research Division Texas A&M University	Box 9864 College Station, Texas 846-1983
Mr. C. B. Francis	State Employment Office Galveston	1926 Sealy Street Galveston, Texas 763-8571
Mr. Ralph Hagood	Marathon LeTourneau Co.	P. O. Box 2198 Brownsville, Texas 831-4561
Mr. J. B. Hardy	State Employment Office	1926 Sealy Street Galveston, Texas 763-8571
Capt. Robert L. Jones	International Organization of Master Mates and Pilots	305 Moody Street Galveston, Texas 762-2729

People Interviewed Cont'd

Name	Firm	Address
Mr. E. O. Kirkham	Todd Shipyards	Pelican Island Galveston, Texas 744-4581
Mr. Joel B. Kirkpatrick	Galveston Daily News	8522 Teichman Road Galveston, Texas 744-3611
Commander J. I. Leaish	U.S. Coast Guard Customs House	18th Street and the Strand Galveston, Texas 763-1211
Mr. Eddie Menochi	National Maritime Union of America	1902 Mechanic Galveston, Texas 762-9669
Mr. John Mehos	Liberty Fish and Ice Co.	7th and Warf Streets Galveston, Texas 762-8661
Mr. Ned Middleton	Brazosport College	Oceanic and Marine Technology Department 500 College Drive Lake Jackson, Texas 77566 233-1915
Mr. John Mitchell	Rockport Yacht and Supply Co.	Rockport, Texas 729-5431
Mr. Tom Moore	Texas Parks and Wildlife	Hq. Region S. Rockport, Texas 729-2315
Mr. Robert Mauermann	Texas Shrimp Association	First National Bank Building P. O. Box 1066 Brownsville, Texas 75820

People Interviewed Cont'd

Name	Firm	Address
Mr. Robert Nicholls	Western Geophysical	Pelican Island Galveston, Texas 765-9321
Dr. Ranzell Nickelson	Agricultural Extension Service Texas A&M University	3915 Glenn Oaks Drive Bryan, Texas 846-3892
Mr. Felix Ocanas	Corps of Engineers	500 East 10th Street Brownsville, Texas 546-2456
Mr. Guy Pete	Maritime Industries Training Center	Shrimp Turning Basin Brownsville, Texas 831-4278
Mr. Cliff Phillips	Western Geophysical	8100 Westpark Avenue Houston, Texas 781-3261
Mr. C. O. Robert	Gulf King Shirmp Co.	170 Huff Street Aransas Pass, Texas 758-5373
Mr. O. L. Selig (Director, Administration & Finance)	Port of Galveston	802 Rosenberg Street Galveston, Texas 765-9321
Mr. Russell Stogsdill	Architecture Research Center Texas A&M University	700 S. Duter College Station, Texas 846-0515

People Interviewed Cont'd

Name	Firm	Address
Mr. Paul Story	National Marine Engineers Beneficial Association	1802 The Strand Galveston, Texas 762-8439
Capt. T. K. Treadwell	Oceanography Department Texas A&M University	4201 Nagle Bryan, Texas 846-0209
Lt. Comdr. William Whaley	U.S. Coast Guard Customs House	18th Street and the Strand Galveston, Texas 763-1211

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